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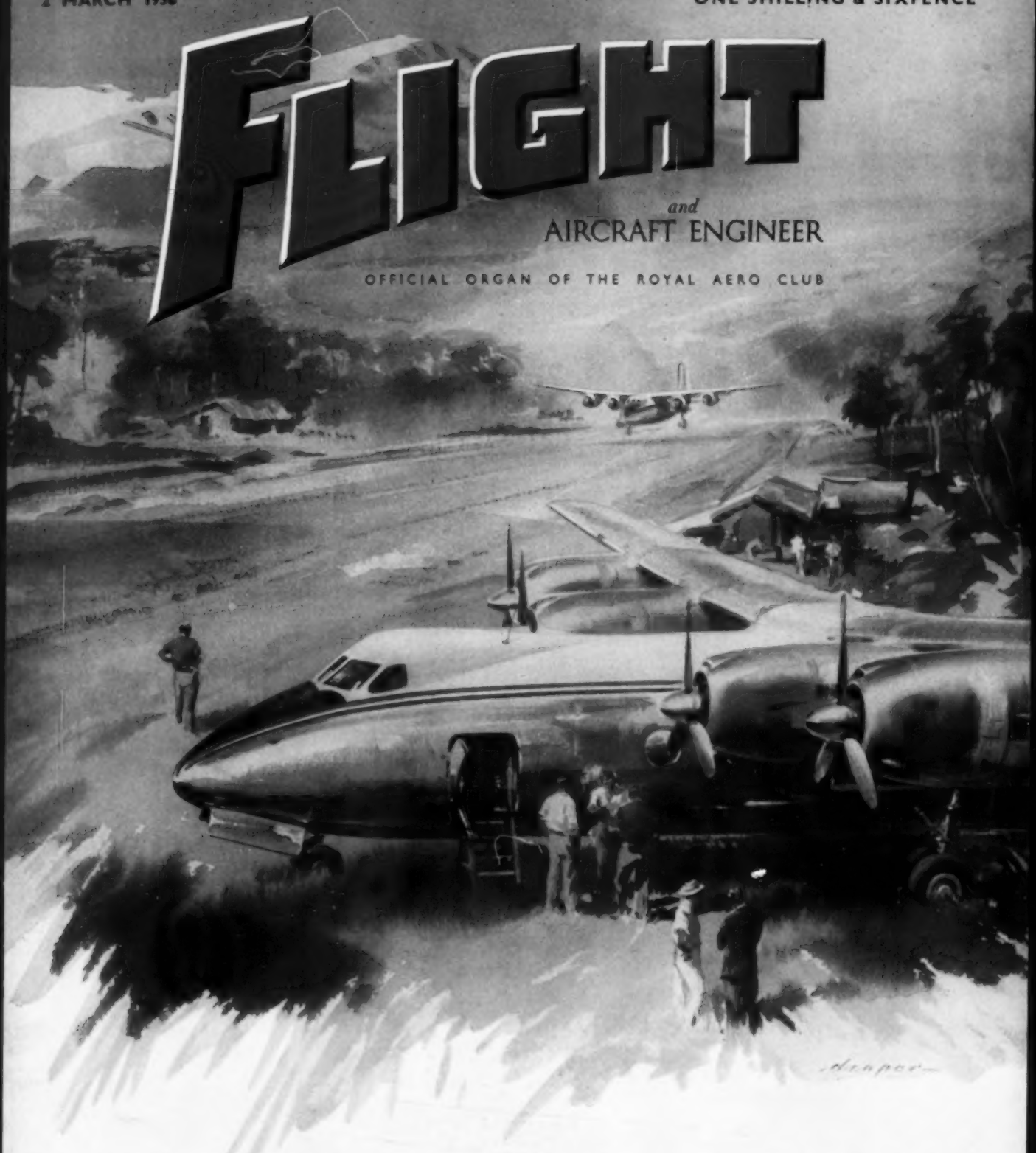

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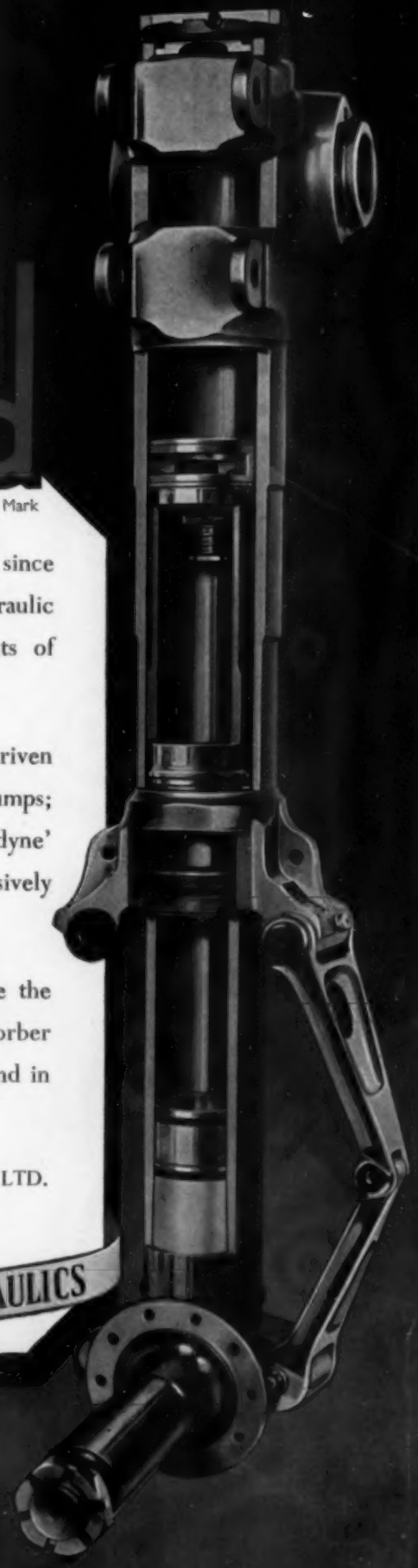

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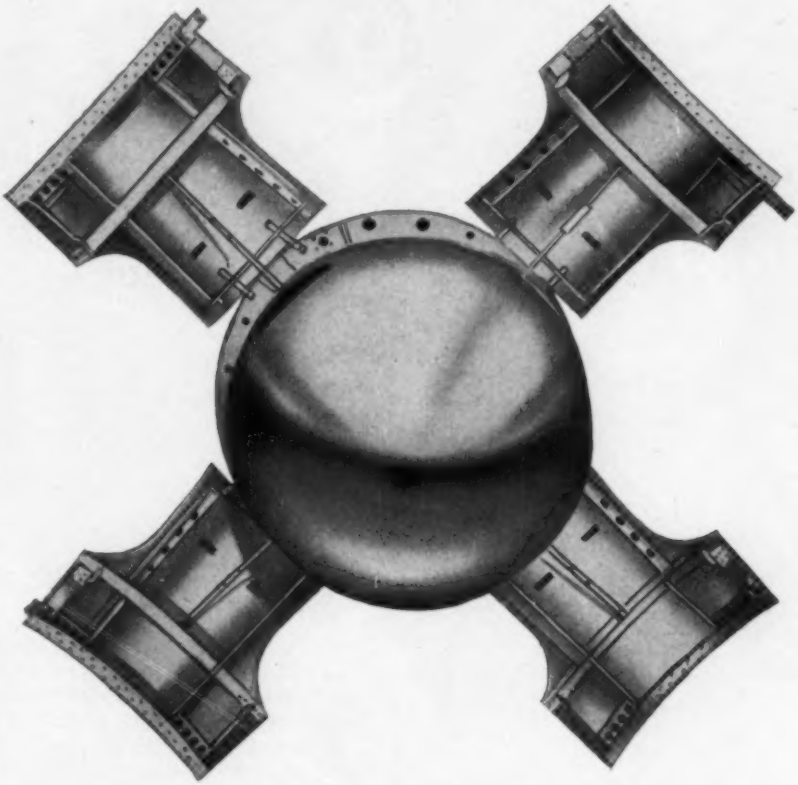

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"'Tis no time to ponder" retorted the Squire, "Haste!"

"Very well then, I suppose thou knowest best." Sir Percy grasped his sword, swung his cloak, and leapt into a world of darkness; he was pleasantly surprised to land on something soft and yielding. "Gad!" he beamed, "the age of miracles is not yet past." From beneath him, oddly muffled, the Squire's voice choked; "'Twould be uncommon kind of milord to remove his scabbard from the small of my back."

"Faith!" cried the cavalier — "here is a waggish situation indeed. Meseems I made a splendid landing on thy broad and faithful back. And where didst *thou* come to earth, old friend?"

The Squire squirmed uneasily. "Verily I could not swear to it, but if I mistake me not, we are in the cattleyard." His movements were accompanied by an odd squelching sound. "Verily thou wert unfortunate," said Sir Percy with soldierly sympathy — "perhaps that will teach thee the folly of a spring in the dark. And speaking of springs" — he spake with a knowledge surprising in one of that period — "Didst know that the most inferior springs may look exactly like a genuine high precision job, guaranteed for years of high performance? What! not interested in springs? Ah, well, perhaps a tub would suit thee better." He ambled off into the darkness . . .

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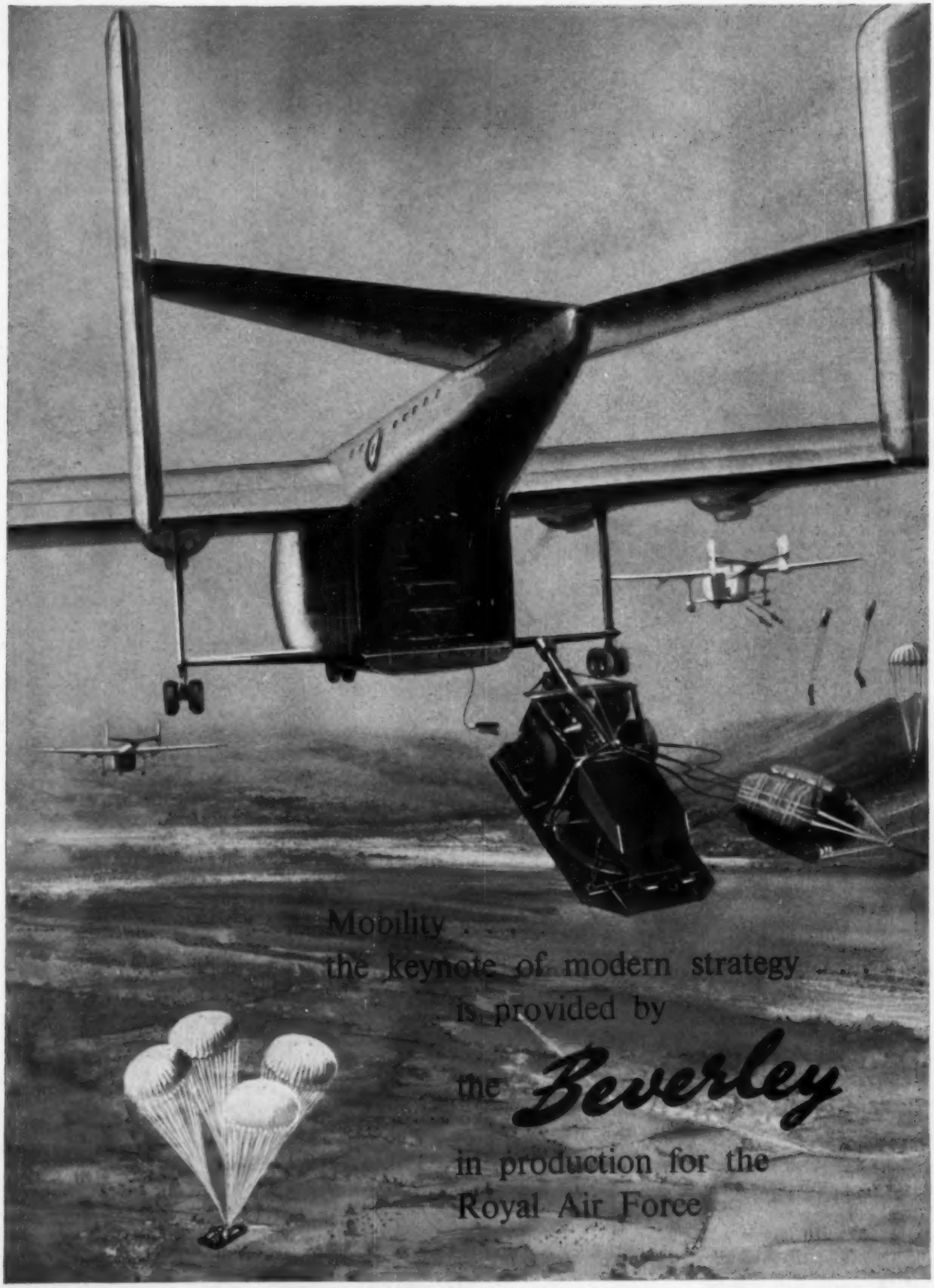

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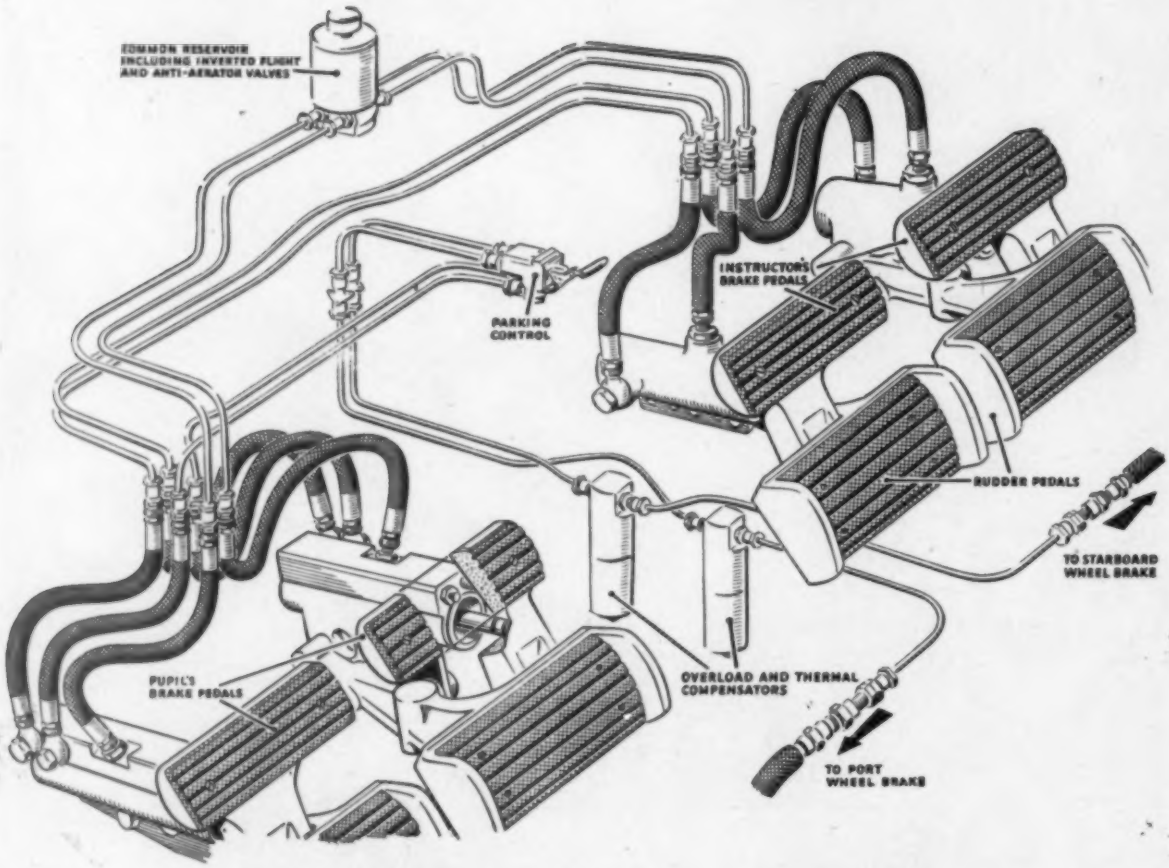

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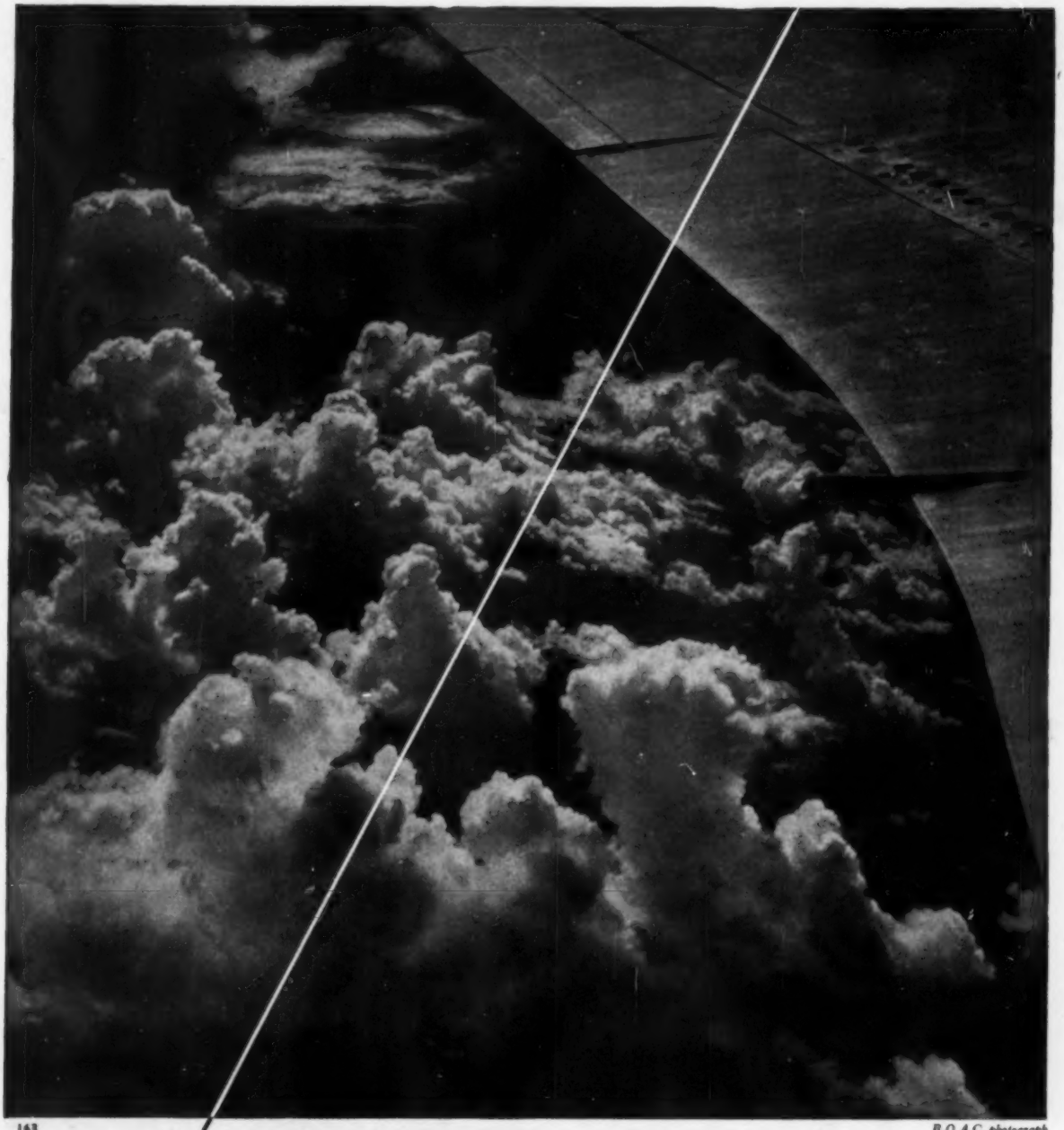

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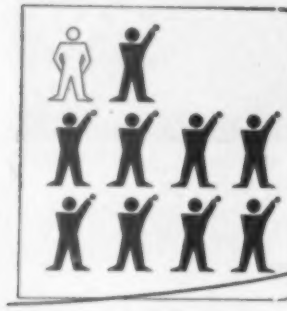

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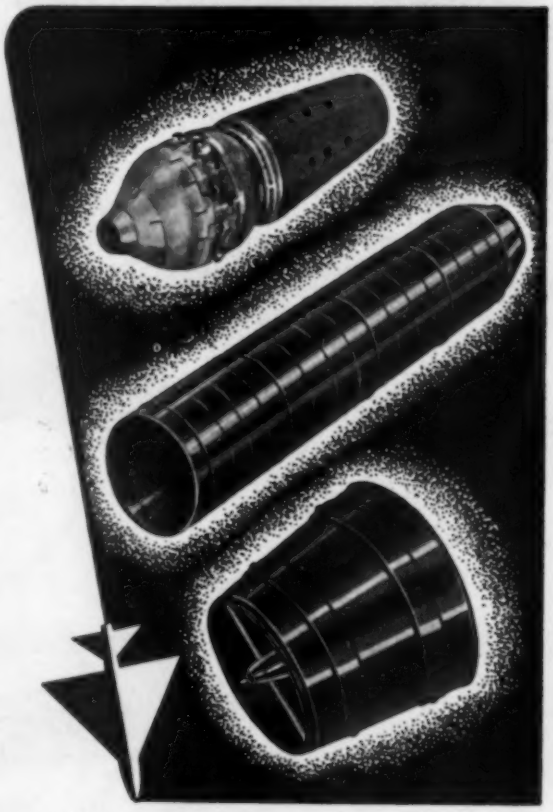

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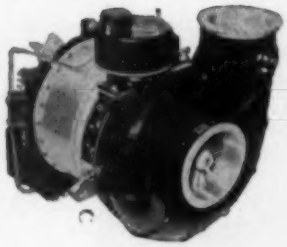

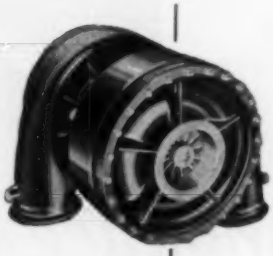

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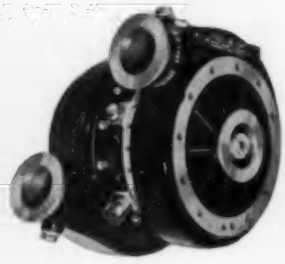

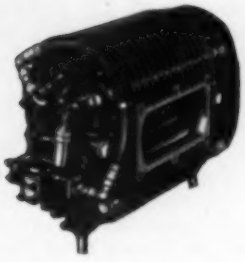

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FLIGHT
and
AIRCRAFT ENGINEER

No 2458 Vol 69 FRIDAY 2 MARCH 1956

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Missile Miasma—

ROUND Britain's guided-missile programme swirl the unhealthy vapours of rumour, contradiction, blind assertion and evasion. An occasional flash of truth lights up the murky scene or a wise utterance arrests the flood of calumny; but overall there is mistrust and misgiving.

We recently voiced our hope for a straight answer to the alarming suggestion that the Hunter is incapable of carrying air-to-air missiles, and Sir Frank Spriggs was quick to speak up for Hawker Aircraft. There was no truth in the suggestion, he said: the Hunter had flown repeated tests with exact replicas of guided missiles and thus equipped had achieved supersonic speed. He added that the Fairey Fireflash was now being fitted to a Hunter and that the Javelin (which had come in for similar criticism) would fulfil its designed function of missile platform in every way.

It soon became clear, however, that the Hunter trials were being conducted as a private venture, possibly with an eye to the export market, and the Defence Debate confirmed that the first generation of air-to-air guided missiles for the R.A.F. would be brought into service with a special mark of the Swift "to gain experience of this type of weapon". As the Swift has long been out of the running as a high-altitude intercepter, the public will find scant reassurance in this disclosure.

Surmise that the Service might yet be armed with American missiles was strengthened when it became known that the R.C.A.F. was to standardize the Hughes Falcon and not the indigenous Velvet Glove; but Britain's missile policy was to some extent restored in public esteem by broadly couched official disclosures, summarized on the next page. There has been, too, a report that much effort is being concentrated on a new de Havilland air-to-air weapon using infra-red detection. This, it may be supposed, will join, or supplant, the Fireflash in the R.A.F.

—no British Monopoly

From these air-to-air missiles to the ground-to-air weapons for a future phase of our defence may prove a lengthy step, both in time and in technical complexity; but at least we now have the assurance that a system which phases-in early-warning, tactical-control and tracking radar, and fires the missiles automatically, is in prospect. We know, too, that nearly two years have elapsed since a British ground-launched missile first scored a hit on a pilotless aircraft (though the target was at the modest level of 10,000ft).

As for intercontinental ballistic missiles, Sir Frederick Brundrett, leader of Britain's delegation to the Commonwealth Advisory Committee on Defence Science, has said that Britain has left research to the Americans; which may mean that a weapon such as the Convair Atlas may be licensed to us and that it may be powered with North American rocket engines, of fantastic thrust, built by Rolls-Royce. In any case, the *Statement on Defence* gives the assurance that particular emphasis is being placed on the development of the ballistic rocket as a deterrent to aggression.

Unlike the Hunter/Fireflash farrago, Sir Frederick Brundrett's disclosure aroused curiously little comment and must be set against a recent leading article in the American *Aviation Week*, received after the foregoing paragraphs were written. In title and theme the article accords with the present dissertation and contradicts a U.S. senator with these words: "Everyone who has even the remotest connection with the missile program knows that the United States has no stockpile of intercontinental ballistic missiles; that it has none in operational service; that the first ICBM developed program (Convair) is still in the prototype construction stage and that the second ICBM program (Martin) was just begun a few months ago."

So the missile miasma is not a phenomenon of these islands alone.

SNARK is the U.S.A.F. name for the Northrop SM-62 strategic missile now on test at Patrick Air Force Base. As seen here, it is in the nature of a pilotless bomber, turbojet-powered. Speed is about 600 m.p.h., range 5,000 miles, navigation by "automatic celestial means."

FROM ALL QUARTERS

British Missiles

OF all Britain's efforts in the sphere of defence, that of guided-weapon development has been particularly closely wrapped in secrecy. This has had results which have been at once advantageous and frustrating, but there are now signs that security in this sphere is being eased as weapons reach the production stage.

It is now clear that this country deliberately gambled on the maintenance of peace (or, at worst, a state of cold war) between World War 2 and some period after the end of this year. This is clear from the fact that our missile thinking has been aimed solely at the evolution of advanced types of weapon; we have deliberately ignored a whole generation of earlier missiles (such as Nike) whose performance will probably not be sufficient for the requirement of future warfare.

Guided-weapons systems involve new and precise techniques in diverse scientific fields. Three years ago it was announced that over 100 British firms were heavily engaged in the missile business, and they are supported and guided by the research establishments of the Ministry of Supply. Chief of these establishments are the R.A.E. Farnborough, together with the Rocket Propulsion Development station at Westcott, the Radar Research Establishment at Malvern, the National Gas Turbine Establishment at Pyestock, the Explosives R.D.E. at Waltham Abbey and the Admiralty Signals R.D.E. at Portsdown. Field trials began on limited ranges at Larkhill on Salisbury Plain and are now being intensified at Aberporth on Cardigan Bay and Woomera, made available by the Australian government. The latter facility is officially considered "second to none".

Surface-to-air missiles have now reached the point at which production orders have been placed for one type of weapon. An air-defence weapons system has been evolved which, in theory, should be able to operate independent of human aid. Early-warning radar is the first vital factor in providing what its name implies and in offering information from which a rough assessment of the raid can be obtained. Tactical control radar can then take over and count the enemy aircraft, calculate their speeds and direction, and pin-point each target with sufficient accuracy for the final stage. The latter comprises tracking radars associated directly with the guided-weapons systems. These sets will lock on to individual targets and control individual missiles.

A great variety of possible guidance systems is available to the surface-to-air missile designer. One of our earliest test vehicles, RTV-1, (illustrated in *Flight* on July 15th and August 26th, 1955) was used for extended trials of beam-riding systems. In the course of these trials, on April 7th, 1954, a round with a proximity fused warhead was fired at a Firefly 8 target flying at approximately 10,000ft altitude and 8,000yd range. This was the first target destroyed by a fused missile warhead in British development. The miss-distance at which the warhead exploded seems to have been about 35ft.

Altogether, more than 1,000 test vehicles have been fired at Aberporth alone. These involve not only ground-to-air missiles but also air-to-air, ship-to-air, air-to-ground, ground-to-ground and other types of missile. Ship-to-air development has been assisted by a device officially termed Clausen's rolling platform, comprising a structure reminiscent of a Thames-estuary fort floating in a man-made basin and constrained to pitch and roll, simulating a cruiser or other vessel in a heavy sea. Missile systems, including their guidance functions, can then be evaluated under realistic conditions.

The air-to-air weapon now described as "Fireflash," evolved by the Fairey Aviation Company's Weapons Division at Heston, is now in full production and is soon to enter service associated with a special mark of Supermarine Swift.

It is certain that there must be a large number of actual weapon-development programmes at present in an active stage in this country. The Controller of the Weapons Research Establishment near Adelaide (*Flight*, August 26th, 1955) said recently that increasing numbers of staff at Woomera were now being transferred from range development to actual test firings.

"FLIGHT"

As the continuance of the dispute in the printing trade necessitates amendments to printing schedules, this issue is reduced in size and copies may be late in reaching readers. To all who are inconvenienced in any way we offer our sincere regrets in circumstances beyond our control.

Joseph Smith

WE record with regret the death, at Chandler's Ford, Hampshire, on February 20th, of Mr. Joseph Smith, C.B.E., chief designer to the Supermarine Works of Vickers-Armstrongs, Ltd. He was 58.

Mr. Smith was born on May 25th, 1897, and was educated at Yardley Secondary School and Birmingham Municipal Technical School. After serving an apprenticeship with the Austin Motor Company he was appointed a junior draughtsman in the aircraft section, and in 1921 transferred to Vickers-Armstrongs, Ltd., as senior draughtsman. Five years later he became chief draughtsman. Under R. J. Mitchell he was responsible for much of the original design of the Supermarine Spitfire, and after Mitchell's death in 1937 was appointed chief designer. All subsequent development work on the Spitfire was under his leadership and since the end of the war he had been associated with the Spiteful, Seafang, Attacker, Types 510 and 535, Swift, Types 508 and 525, and the new N.113, adopted as a standard day fighter/strike aircraft for the Fleet Air Arm.

Mr. Smith.

In 1948 Mr. Smith was appointed a special director of Vickers-Armstrongs, Ltd. He served as chairman of the technical board and technical executive committee of the Society of British Aircraft Constructors from 1948 to 1951, and in 1950 was awarded the silver medal of the Royal Aeronautical Society.

Major C. F. Abell

WE also record with regret the death of Major C. F. Abell, O.B.E., F.R.Ae.S., M.I.M.E., who retired at the end of 1954 as service manager of the Bristol engine division after 28 years' service with the company. He died at his home at Budleigh Salterton, Devon, on February 18th, after a long illness.

Educated at Sherborne and Leeds University, from 1915 to 1919 Charles Francis Abell served in the R.N.A.S. and R.F.C. After the war he joined the editorial staff of *The Automobile Engineer*, leaving in 1922 to become works manager of Sheffield-Simplex, Ltd. He joined the Bristol engine division on January 1st, 1927. For some years manager of the experimental department, he later became service manager, an appointment he held until his retirement.

One of the first tasks undertaken by Frank Abell for Bristol was to supervise the installation of the Mercury engine in the Short Crusader for the 1927 Schneider Trophy race. Before he retired, he had seen the Proteus turboprop installed in the Britannia and the Olympus turbojet in the Avro Vulcan. Maj. Abell leaves a widow.

STATEMENT ON DEFENCE

The "Nuclear Counter-offensive": Close Defence "Outmoded"

PRESENTED to Parliament on February 17th, the *Statement on Defence, 1956* [H.M.S.O., price 1s 3d], sets out the following considerations:

"The increased power of the deterrent, that is, the nuclear weapon and the means of delivering it, has made global war more frightening and less likely. Our first and chief objective must be to prevent war by the maintenance of the Allied deterrent, to which we have begun to make our own substantial contribution. It is our belief that given the deterrent, given a robust faith on the part of the free world in the strength of their institutions, and given the continued growth of NATO's defensive power, global war can be prevented. In the deterrent must be included an effective early warning system and the ability of the forces of the North Atlantic Treaty Organization to hold the line by land, sea and air until the nuclear counter-offensive has broken the back of the enemy assault.

"It is sometimes argued that, with the build-up of a stock of thermonuclear bombs by the Russians the deterrent value to the Western Powers of building up a stock of bombs and the means of delivery will diminish. This is not so. The objective of the Western Powers is defensive. They will never be the aggressors, but they must have, and be known to have, the power of instant and overwhelming retaliation if attacked. It is the retaliatory power which is the vital factor.

"Apart from preventing global war we have to be prepared for the continuance of the cold war . . . Equally we have to be prepared for the outbreak of localized conflicts on a scale short of global war. In such limited wars the possible use of nuclear weapons cannot be excluded."

The cost of new weapons, the Paper continued, was increasing, and would go on increasing. This meant that any long-term defence programme based on the maintenance of forces at their present level would show a steadily and steeply rising curve of expenditure. Since, failing some radical change for the worse in the international situation, there was a point beyond which expenditure on defence could not be allowed to rise, one consequence of equipping our forces with the new weapons which were essential to their efficiency in the new strategic conditions was a decline in their numbers.

There had been signs recently of overloading in the Research and Development programme due to spreading the programme too widely.

The fire power and lethality of fighter aircraft would be markedly increased by equipping them with air-to-air guided missiles. The first generation of missiles would become available from production in the course of 1956-57. They would be brought into service with a special mark of the Swift, and would be used to gain experience of this type of weapon. Although manned fighter aircraft and their weapons would improve, the surface-to-air guided weapon might well in time play a predominant part in Air Defence. A production order had been placed for these weapons for trials with the Air Defence system. Because of the area of destruction of nuclear weapons close defence of vulnerable areas was an outmoded concept. Our aim was a guided weapons system which could break up enemy attacks before they penetrated over the coastline and which could be integrated with our fighter defences.

Increasing importance attached to the ability of our air forces overseas, including the R.A.F. Regiment, to support local operations. The use of the Pioneer for jungle work in Malaya had provided valuable experience which would be applied to the future employment of aircraft of this type.

Work on the development of a variety of nuclear weapons continued to expand. The progress made was such that two further series of tests were to be held in 1956; the first would be in the Monte Bello Islands in the spring and the second would be later in the year, at Maralinga, in South Australia. The latter series of tests would be the first to take place at the site which, with the co-operation of the Australian Government, was being developed as a weapons proving ground.

Particular emphasis was being placed on the development of the ballistic rocket as a deterrent to aggression.

Increasing effort was being devoted to the solution of the problems of flight at high supersonic speeds, including the problems of take-off from and landing on existing airfields and aircraft carriers. Various methods of achieving vertical or near-vertical take-off and landing were being explored.

In an appendix the following figures were given for the strength of the R.A.F. (in thousands):—

	Apr., 1955 (actual)	Apr., 1956 (estimate)	Apr., 1957 (estimate)
Regular	180.1	162.6	167.8
National Service	70.2	75.5	70.4
Women	7.9	6.4	5.8
Total ...	258.2	244.5	244.0

THE AIR ESTIMATES

WHEREAS last year's (1955-56) Air Estimates showed an increase of some £22½m over those for 1954-55, the new Estimates (1956-57), published* last week, indicate a fall of rather under £34½m; without allowance for American aid, this figure becomes a little under £23m.

As is customary, publication of the Estimates was accompanied by the appearance of an explanatory memorandum† by the Secretary of State for Air, Mr. Nigel Birch. Principal points of interest from this memorandum are abstracted below.

The net total of Air Estimates for 1956-57 [says the Air Minister] is £479,500,000, compared with £513,900,060 for 1955-56. This allows for our receiving £38,000,000 out of the aid given by the United States of America towards the defence effort undertaken by the United Kingdom. This sum represents dollar and sterling payments to be made in respect of aircraft and equipment in the production programme of the Royal Air Force and includes money expected to be outstanding from the provision made in 1955-56. The corresponding figure for 1955-56 was £26,500,000. We are greatly indebted to the United States Government for their continuing generosity. Without deducting American aid, the comparison is between £517,500,000 for 1956-57 and £540,400,060 for 1955-56.

The production programme will be seriously underspent in 1955-56. Orders for certain marks of the Swift were cancelled after the Estimates were published, and orders for the Javelin were adjusted in order to provide a better balance between the early and later marks in view of production delays which had already occurred. In addition, the development of advanced types of aircraft and equipment has continued to meet many difficulties and there has been some loss of production due to strikes. The provision for aircraft and equipment in 1956-57 has been reviewed in the light of the underspending in the current year and some revision of future requirements. The gross estimate for Vote 7 is £29,500,000 less than the estimate for 1955-56.

The Estimates include provision for the receipt from the Federal German Government of Deutschemark support for the Royal Air Force in Germany to the value of £9,500,000. The gross local expenditure in Germany is expected to be about £13,000,000 and provision for it is taken under the appropriate Votes.

Rôle of the Royal Air Force, its Organization and Equipment. The foundation of our strategy [says the Air Minister] remains to build and maintain, in conjunction with our American allies, an effective nuclear deterrent. Air defences are an essential complement to the deterrent. We must also continue to provide such active forces as may be needed in the cold war and for limited wars.

Our contribution to the nuclear deterrent will rest mainly upon the power of the "V" bombers. The first Valiant squadrons have been formed. The Valiant has undergone successful proving trials and the squadrons are working up. A small number of these aircraft will be used in the forthcoming trials of atomic weapons.

The Vulcan and the Victor represent a more advanced stage of development than the Valiant. We expect to see the Vulcan in service during the coming year. Both the Victor and Vulcan have a development potential of which we propose to take advantage. Since quality is of paramount importance, our plans provide for a high proportion of these advanced aircraft in the "V" bomber force. With this in view we have cancelled orders for a number of Valiants. But the Valiant will provide an effective contribution to the deterrent for many years. As the build-up

*"*Air Estimates, 1956-57," price 8s 6d, H.M.S.O.* †"*Memorandum by the Secretary of State for Air to accompany Air Estimates 1956-57," price 6d, H.M.S.O.*

THE AIR ESTIMATES . . .

of the "V" force continues the strength of the Canberra force will fall, but substantial numbers of Canberras will continue to be employed in the tactical rôle.

The larger part of the day fighter squadrons has been re-equipped with Hunters. The handling qualities and manœuvrability of the Hunter in the hands of squadron pilots were demonstrated in public last summer. Modifications to meet the development troubles are being progressively incorporated in aircraft in service. Javelins are now in service in Fighter Command and we can look forward to a progressive build-up of Javelin squadrons. The English Electric P.1 flew at Farnborough and shows great promise.

After a review of our fighter requirements as a whole we have decided to cancel some Hunters now on order, in order to make money available for the purchase of other types of aircraft.

The first air-to-air guided weapons will be delivered during the coming year. They will be used to develop operational and handling techniques. For surface-to-air guided weapons our plans envisage the progressive build-up of a system designed for weapons with an advanced performance capable of dealing effectively with enemy bombers well out to sea. This will take time. A production order has now been placed for the first of these weapons for full-scale Service trials.

During the coming year the Mark 3 Shackleton with tricycle undercarriage and more powerful engines will be introduced into service with Coastal Command. We have cancelled orders for some of these aircraft and for Seamews, because we foresee that other commitments must take precedence over these portions of our programme.

Britannias have been ordered for Transport Command. The Comet 2s will also be a valuable addition to the Command. The delivery of the Beverley heavy freighter has been delayed by difficulties encountered in the final stages of development, but these are being overcome.

In the Second Tactical Air Force, the fighter reconnaissance version of the Swift is now in service and we expect the Canberra night interdictor to reach the squadrons during the coming year. The fighter squadrons have been largely re-equipped with Hunters, thanks to the generosity of the American Government.

The F-86E Sabre aircraft in service with the R.A.F. are being replaced by Hunters, delivered from an off-shore procurement contract placed by the United States Government in the United Kingdom . . . under a separate arrangement, the Americans are giving us over 100 more Hunters. This is over and above the financial assistance referred to above.

Operations in Malaya are then reviewed, and the Minister goes on to review various major exercises, training operations and notable flights that have taken place during the year. He adds that there has been a further decrease in the fatal and major accident rates during 1955 despite the increased complexity of the aircraft now in service. The major accident rate for all types of aircraft is the lowest recorded for ten years and the fatal accident rate for jet- and piston-engined aircraft combined is the lowest recorded for 20 years.

Economy in Manpower.—The decision that the strength of the Armed Forces is to be reduced by 100,000 by April, 1958, means that the R.A.F. must come down by then to about 235,000 men. Extensive manpower economies have been made in the last year. As a result of these [the memorandum continues], together with some reduction in our requirements, we now expect that the strength of the R.A.F. at 1st April, 1956, will be about 245,000, compared with the forecast of 254,000 made a year ago.

A number of experiments have been carried out at selected R.A.F. stations, with special emphasis on problems of organization and management, including the number and distribution of highly skilled and supervisory personnel. The first of these experiments (in Transport Command) led to the saving of some hundreds of men; and we expect that the continuation of such studies, reinforced by the use of work study, will eventually yield further considerable manpower economies.

During the past few months another committee, again under the chairmanship of Sir Leslie Hollinghurst and including among its members Mr. F. C. Hooper and Mr. J. Crawford, president of the National Union of Boot and Shoe Operatives and deputy chairman of the British Productivity Council, has been examining the arrangements in the R.A.F. for the servicing and repair of aircraft and other technical equipment with a view particularly to securing economies in skilled technical manpower.

Recruiting and Manning.—Under this heading the Minister states that a new aircraft category is being introduced, the Air Electronics Officer, primarily for service in the "V" bombers. The highly complex electronic equipment which these aircraft carry, he points out, calls for a high level of technical skill and responsibility.

In the ground branches, the numbers and quality of candidates for commissions are disappointing. But the number of entrants to the Technical Branch through the R.A.F. Technical College, Henlow, and the University Cadetship scheme rose from 31 in 1954 to 52 in 1955.

Regular recruiting has declined and the strength of regular airmen and airwomen fell from 157,400 at the beginning of April to 142,800 in December, and may be down to about 139,500 in March. This has meant that in spite of reduced requirements of men, the proportion of National Service men in the force has increased.

The manning situation in the more highly skilled trades in the four engineering trade groups has improved slightly but is still far from satisfactory. There is no longer a numerical shortage but far too many men in these trades are either short-term regulars or National Service men.

THE VOTES

THE Air Estimates are always divided into "votes", of which there are eleven, each covering a particular field in which expenditure is required. These are listed below, the gross estimate being followed by the 1955-56 figure in brackets. Reasons for increases or decreases then follow.

Prior to the passage of these votes must be Vote A, which lays down the strength of the Air Force in personnel. This year the maximum authorized strength is 257,000 in the service of the Air Force, a decrease of 15,000 on 1955-56. This is made up of 27,400 officers (26,000 R.A.F., 500 P.M.R.A.F.N.S., 500 W.R.A.F., 80 local forces abroad and 320 in other Commonwealth air forces) and 229,600 airmen and airwomen (220,000 R.A.F., 5,200 W.R.A.F., 3,920 local forces abroad and 480 in other Commonwealth air forces).

Vote 1: Pay, etc., of the Air Force.—£113,660,000 (£91,960,000). The enormous increase in this vote of £21,700,000 (nine times the 1955-56 increase) is brought about almost entirely by the provision for substantial increases in rates of pay and bounty schemes.

Vote 2: Reserve and Auxiliary Services.—£3,197,000 (£2,802,000). As in previous years the major portion of the increase (of £395,000) in this vote arises from provision of reserve pay for Class E reservists. Increases in rates of pay have also had their effect. Maximum strengths are to be: 17,000 officers (6,900 R.A.F.R.O., 100 P.M.R.A.F.N.S., 10,000 R.A.F.V.R.), 218,000 airmen and airwomen (214,000 in classes E and H and 4,000 R.A.F.V.R.), together with 2,500 officers and 8,500 airmen and airwomen in the R.Aux.A.F., 81 whole-time officers, 412 part-time officers and 19,406 observers in the R.O.C. and 3,600 officers, 800 W.O.s and 36,500 cadets in the A.T.C.

Vote 3: Air Ministry.—£4,987,000 (£4,676,000). As is normal, the £311,000 increase results from increases in pay and salaries. Total staff, at 8,314 is slightly increased.

Vote 4: Civilians at Outstations.—£41,376,000 (£39,359,000). This £1,837,000 increase in gross vote results largely from higher pay and extra non-industrial staff, although there has been a reduction in the industrial staff.

Vote 5: Movements.—£16,860,000 (£14,960,000). An increase of £1,900,000 is due mainly to provision to movement expenses in Germany, increased use of civil aircraft for personnel and priority cargo to and from oversea Commands and to greater movement of personnel by sea. A reduction has been effected in sea-borne stores and supplies.

Vote 6: Supplies.—£82,240,000 (£91,880,000). The reduction in this vote of £9,640,000 arises from such factors as reduced provision for liquid fuel resulting from a re-assessment of flying effort in the light of experience gained with new types of aircraft and from deferment of the change from non-dutiable to dutiable fuel on certain aircraft. Nevertheless provision has had to be made for solid fuel and electricity supplies in Germany and for increased home costs of these items.

Vote 7: Aircraft and Stores.—£263,000,000 (£292,500,000). This gross vote has fallen by no less than £29,500,000 as a result of revised assessment of deliveries of aircraft, explosives, armament and radio equipment. As an example, the vote for airframes has been reduced from £80m to £65.5m, this item having been heavily provided for in 1955-56 in contracts which—for reasons well known to our readers—have by no means all been met. The sub-heading "aircraft" includes airframes, already mentioned, together with aero engines (£74.5m) and spares, components and accessories (£25.5m), both of which are slightly reduced. Other appropriations are: armament £7.25m, ammunition and explosives £23.25m, radio and radar £19.65m, electrical equipment £9.35m (an increase), instruments and photo equipment £8.5m and M.T. vehicles and marine craft £9.75m (a slight increase). Appropriations-in-aid under this vote have risen from £64.5m to £79.5m; of this, most is due to the increased M.D.A.P. grant from the U.S.A. of £12.5m for special aircraft purchase and £25.5m for additional R.A.F. deliveries.

Vote 8: Works and Lands.—£72,520,000 (£72,100,000). The slight increase stems from increased provision for maintenance—partly offset by reduced provision for new works services and plant. Appropriations-in-aid are increased from £19,100,000 to £23,520,000 largely by contributions "from another government."

Vote 9: Miscellaneous Effective Services.—£10,066,000 (£8,709,000). A rise of £1,357,000 mainly due to extra teleprinter and telephone services and to greater expenditure on education of children at overseas stations, particularly Germany.

Vote 10: Non-Effective Services.—£7,366,000 (£5,907,000). A rise of £1,459,000 brought about by general all-round increases in retired pay, allowances, pensions and gratuities.

Vote 11: Additional Married Quarters.—£4,200,100 (£3,800,100). As is normal, all but £100 of this gross vote are met by appropriations-in-aid.

The appendices to the Estimates cover rates of pay, remuneration of civilians, staff training and provisions made for medical, educational and meteorological services.

A significant event in the development of global bombing strategy was this recent simulated refuelling—over Puget Sound—of a Boeing B-52 eight-jet bomber by the four-jet Boeing 707 prototype. A Lockheed T-33 is seen in attendance as an observation machine.

The Long Rifle and its Sight

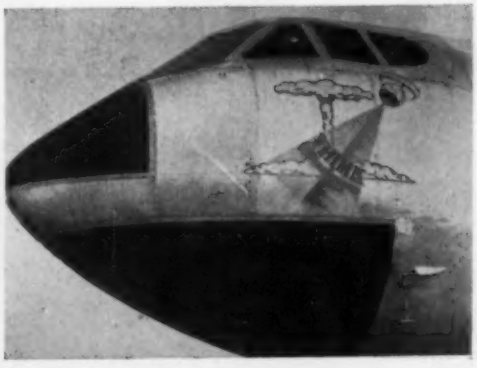
Refuelling for Range and "Brane" for Accuracy

JUST as the Convair B-36 global bomber was quickly dubbed America's "big stick", so its jet-propelled successor, the Boeing B-52, has been styled "long rifle of the air age" (the long rifle, in American history, being the traditional weapon of the backwoodsman, famed for its range and accuracy). To increase the B-52's "built-in" range of over 6,000 miles Strategic Air Command is to receive Boeing KC-135 jet tankers, developed from the Boeing 707 prototype seen above flying a simulated refuelling mission with a "52". KC-135s are in production at Boeing's Renton plant, near Seattle, Washington, and the first should fly this year.

As the KC-135 will greatly extend the reach of the B-52 so the accuracy of the bomber's delivery will be improved by the newly announced "Brane", developed by the International Business Machines Corporation. The name of this device signifies Bombing Radar Navigation Equipment. Originally conceived by the Air Research and Development Command at Baltimore, it is intended for the navigation of the aircraft to its target and for the automatic control of the bombing run. Operational details are, understandably, restricted, but the weight is 1,457 lb, bulk 30 cu ft and cost $300,000 (over £107,000).

During the development period of the present equipment computors and related items were installed in "environmental chambers", there to be attacked by fungi, shaken by explosions, exposed to sleet and heavy rains, whipped by dust and subjected to extreme altitude conditions—all in temperatures ranging from minus 65 deg to 180 deg F.

The name of the International Business Machines Corporation is linked, too, with the immensely powerful computors for America's continental air defence system (Sage) developed by the Lincoln Laboratory of Massachusetts Institute of Technology. Since December 1950 the company has received over $400 million in defence contracts and formed a separate Military Products Division in October last year.



On the left is the periscope of the IBM-built Brane bombing navigation system for the B-52, and on the right is the nose of the particular B-52 in which the system has been developed and tested.

HERE AND THERE

Export Record

JANUARY aircraft exports from Great Britain totalled £7,117,924. This, the highest monthly figure ever recorded, is an increase of £2,714,986 over the total for January last year.

The Little One

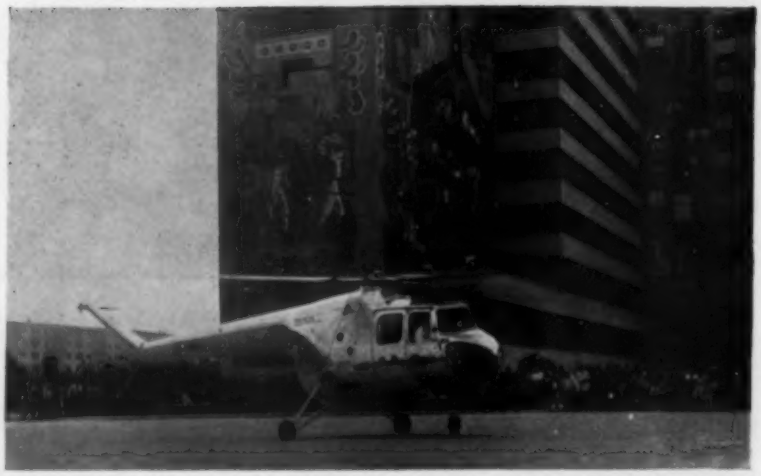
THE Soviet aircraft industry is now producing a "triphibian" two-seater helicopter called Malyutka (the little one) capable of speeds up to 120 km/hr. Ceiling is given as 2,500 metres and fuel consumption "12 kg per 100 km".

Dornier Back in Business

THE West German Ministry of Defence is reported to have ordered no fewer than 428 Do27 single-engined reconnaissance, liaison and communication aircraft for army use. An order is already said to be in prospect for a jet-propelled reconnaissance aircraft for the new German Air Force.

Whirlwinds for Fison Airwork

EACH equipped with eight lightweight passenger seats and dual controls, two Westland Whirlwind helicopters have been bought by Fison Airwork, Ltd., of Bourne, Cambridge. Initially they will be operated in Nigeria under charter from the Shell D'Arcy Petroleum Development Company, in connection with survey and exploratory activities. Delivery of these machines brings Fison Airwork's fleet of helicopters up to ten.



AERONAUTICS AND ART: Standing before the striking murals on the walls of Mexico City's Ministry of Communications building is the Bristol Sycamore after its 2,300-mile flight from Winnipeg. After demonstrations before senior government and Service officials the helicopter left for a tour of Mexican cities.

A Second F.D.2

LAST week the Fairey Aviation Company announced that a second Delta 2 advanced-research aircraft made its first flight on February 15th. Powered, like its stablemate, by a Rolls-Royce Avon (presumably with afterburner) the second aircraft "comfortably exceeded" the speed of sound during its 25-minute flight; the airfield was Boscombe Down and the pilot Peter Twiss.

Research Philosophy

THE subject of the Ninth Louis Blériot Lecture, to be held in the Hall of La Société des Anciens Elèves des Ecoles d'Arts et Métiers, Paris, next Wednesday, March 7th, is *A Philosophy of Aeronautical Research*. The lecturer will be Mr. E. T. Jones, C.B., O.B.E., M.Eng., F.R.Ae.S., president-elect of the Royal Aeronautical Society. The annual Louis Blériot Lecture is sponsored jointly by the Society and the Association Francaise des Ingénieurs et Techniciens de l'Aéronautique (A.F.I.T.A.), and is given alternately by a Frenchman in England and by an Englishman in France.

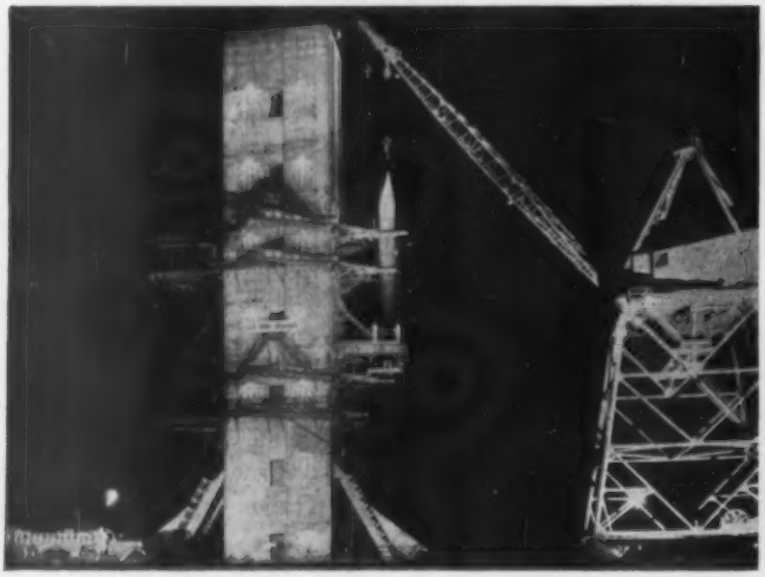
£285,700 for Sarah

A CONTRACT amounting to $800,000 for Sarah survivor search and homing equipment has been placed by the Royal Canadian Air Force with Ultra Electric, Ltd. Weight is about 3½ lb and a signal is transmitted over a radius of 70 miles for up to 20 hr.

Holland's Helicopter Show

AN air show devoted solely to helicopters is planned in Holland for June 16th and 17th at Zestienhoven airfield, near Rotterdam. The organizers are the Royal Aero Club of the Netherlands and the Rotterdam Helicopter Syndicate.

SINISTER NOCTURNE: Reminiscent of the imagined scenes in the Quatermass stories, preparations are made for firing a rocket on the U.S. Army's new static-test stand at Redstone, Alabama. The missile is the Redstone, a V.2 derivative, and is considered as a prototype for the new Army/Navy medium-range (1,500-mile) weapon.

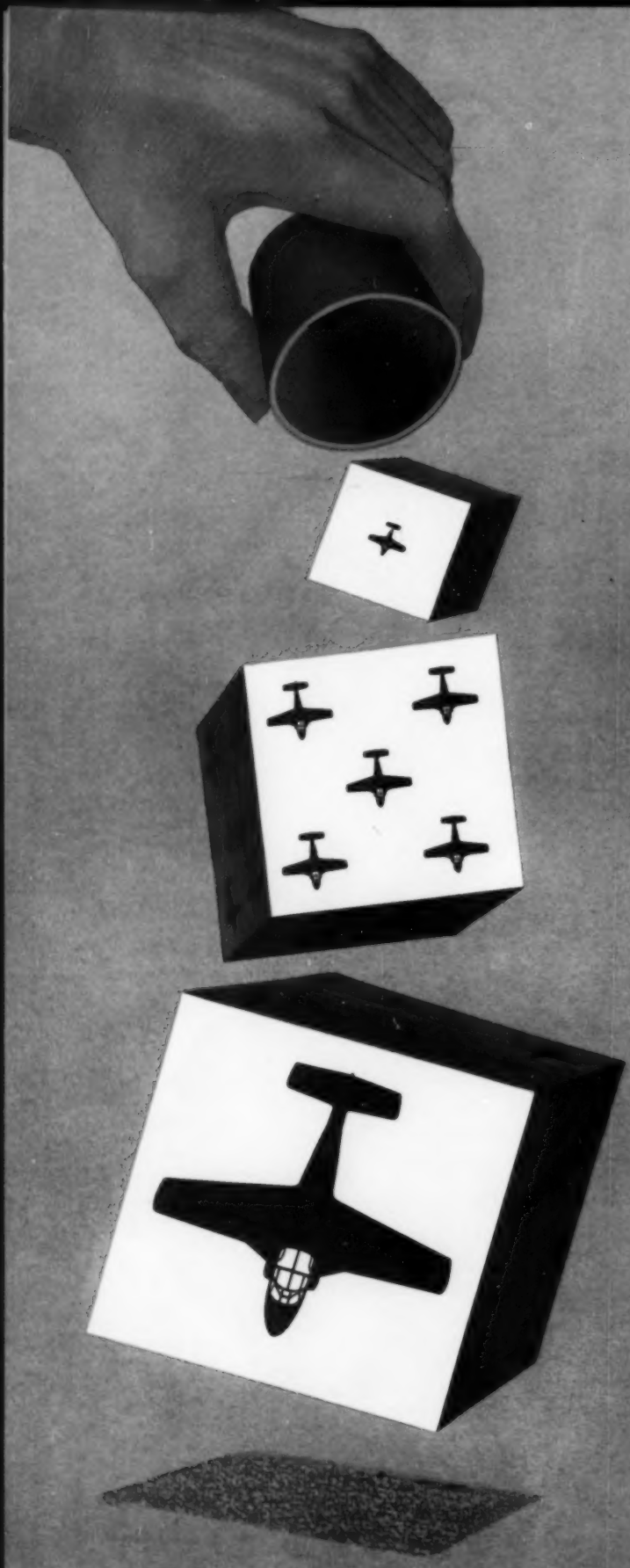


The Cairo Canberra

OFFICIAL figures for the Canberra B.8's London-Cairo flight on February 16th, announced last week by the Royal Aero Club, are as follows: Time from city centre to city centre, 3 hr 57 min 18.9 sec; distance, 2,182.6 miles; average speed, 551.8 m.p.h. The aircraft was powered with Napier-built Rolls-Royce engines, and Napiers say that their contract for these engines is in its final stage; their Netherton factory is now going over to Eland production.

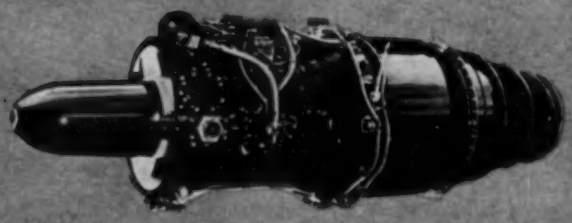
Closer Link

ANNOUNCEMENT was made last week of strengthened association between Air Trainers, Ltd., of Aylesbury, Bucks, and Link Aviation Inc., of Binghampton, N.Y. Following a share transaction, the American firm now owns just over 50 per cent of the issued capital of the English company; and Mr. Allan Williford, president of Link Aviation, has joined Air Trainers' Board. It is also announced that Mr. W. Makinson, formerly Superintendent of the Blind Landing Experimental Unit, Martlesham Heath, and now with the Ministry of Defence, is to join the Board next month.



Luck is no ally...

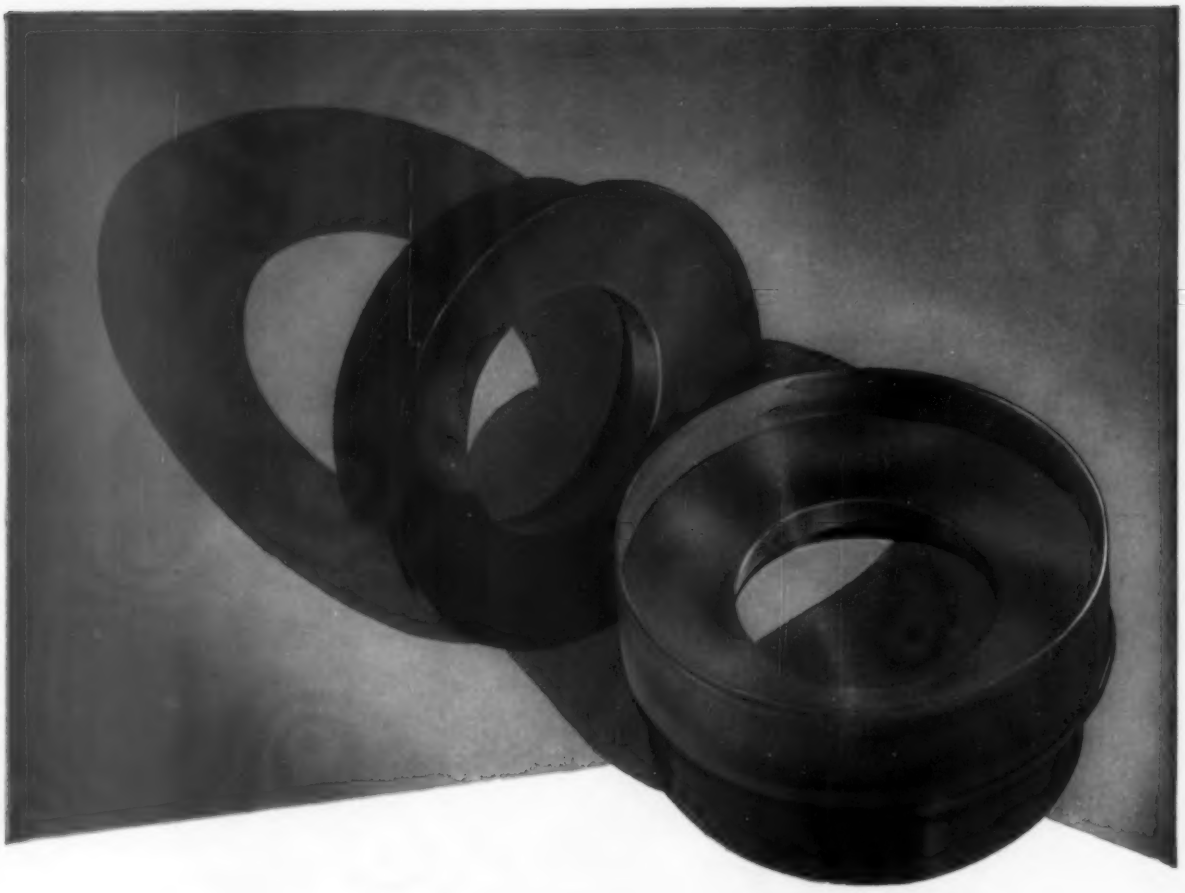
We do not like good luck. In fact, we take considerable care that it plays no part in the evolution of our aircraft engines. Only by testing, re-testing and testing again, only by total elimination of the chance factor has the success been assured of such engines as the Viper turbojet, power plant of Britain's first basic jet trainer.
And only by applying the same relentlessly methodical approach to the further development of these proven types can their great potentialities be fully realised to advance Britain's progress in the air.

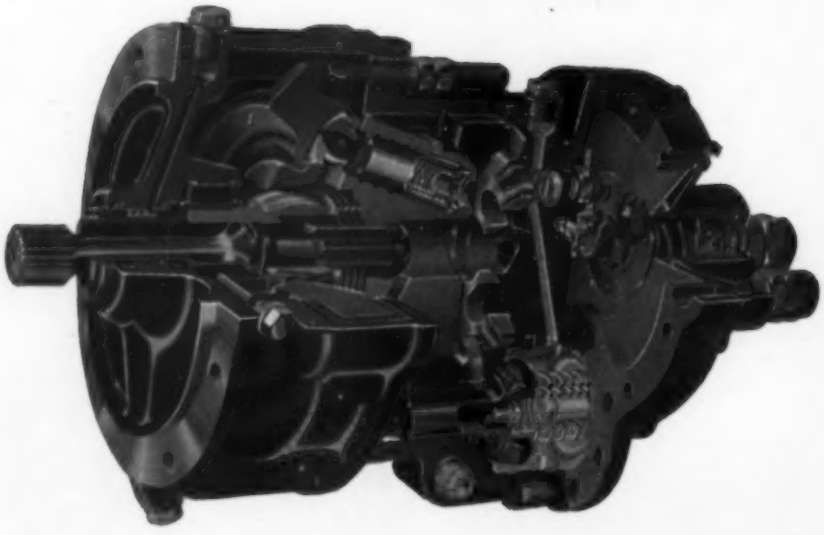


ARMSTRONG SIDDELEY AERO ENGINES

ARMSTRONG SIDDELEY, COVENTRY & BROCKWORTH

Members of the Hawker Siddeley Group





The optical maker's art is applied in producing camplates of super finish and accuracy for 2,000 p.s.i. fuel pumps. Three basic pumps cover present engine requirements with deliveries of 460 to 2,800 gallons per hour.

FUEL AND COMBUSTION SYSTEMS FOR GAS TURBINE ENGINES

LUCAS

JOSEPH LUCAS (GAS TURBINE EQUIPMENT) LTD., BIRMINGHAM & BURNLEY

Lucas-Rotax (Australia) Pty. Ltd., Melbourne and Sydney, Australia.
Lucas-Rotax Ltd., Toronto and Montreal, Canada.

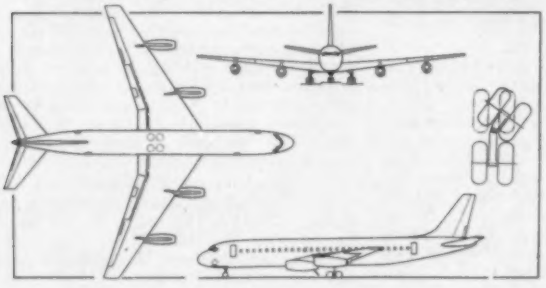
NEW DC-8 DISCLOSURES

Conway Version Offered: First Performance and Cost Data for Four Distinct Models

THE fact that Douglas have definitely settled for the Rolls-Royce Conway as an alternative powerplant for the DC-8 was confirmed by the company on February 17th. Since the DC-8 was first revealed last June Douglas have released for publication only bare details of the two versions being offered—an over-water variant with J75s having a gross weight of 257,000 lb, and a domestic model with J57s (or J75s) of 211,000 lb. Details are now given of four basic types: two domestic versions, one with J57s, the other with J75s, and two over-water versions, with respectively J75s and Rolls-Royce Conways. Design gross weights of each class are 265,000 lb and 287,500 lb. These increases in weight are carried by a further 160 sq ft of wing area, obtained by increasing span with the addition of 2½ft at each root, incidentally providing more capacity for 20,000 lb extra fuel in each case. Fuselage length has been increased by 8ft 4in to allow for the accommodation of a further 19 (tourist) passengers. Dimensions and systems of all versions are identical, but the heavier overwater version has a stronger structure—wings, rear fuselage and tailplane all having heavier skin and stringers. The undercarriage of this version also is stronger, and has furthermore been redesigned for both models, the original "co-axial quad" being replaced by a tandem bogie whose rear wheels are designed to castor for improved ground manoeuvrability (see accompanying illustration).

Of particular interest in the tabulated list of data for the four DC-8 models is the fact that installation of Conways results in a saving of some 4,860 lb in empty weight, as compared with the J75 version, and a difference in zero fuel weight of 3,800 lb. Cost per seat mile of this version is down by 0.07 cents compared with the J75 airliner, and range is increased by some 7½ per cent.

This new three-view drawing of the DC-8 (dimensions of all versions are identical) shows the revised root trailing-edge planform: span has been lengthened by 5ft to restore wing area as weight has increased. A sketch is included of the new four-wheel main bogie with its swivelling rear axle, a complete redesign of the co-axial undercarriage.



DOUGLAS DC-8 DATA

(All range and performance data apply to the payload and weights indicated)

	J57 Domestic First-Class	J75 Domestic First-Class	J75* Overwater Mixed Class	Conway Overwater Mixed Class
Engines	JT3C-4 (J57)	JT4A-3 (J75)	JT4A-3 (J75)	Conway
Design gross weight, lb	265,000	265,000	287,500	287,500
Max. usable T.O. weight, lb	250,000	265,000	287,500	287,500
Design landing weight, lb	189,000	189,000	190,500	190,500
Manufacturer's weight empty, lb	114,489	118,265	120,737	115,877
Operating weight empty, lb	119,726	123,532	128,862	123,726
Design zero fuel weight, lb	161,200	165,000	167,550	163,750
Fuel capacity, lb	114,400	114,400	140,500	140,500
Fuel capacity, U.S. gal	17,600	17,600	21,615	21,615
Capacity payload (space limited), lb	34,280	34,280	35,930	35,930
Number of passengers	122	122	132	132
Cargo, lb	14,150	14,150	14,150	14,150
Range, st. miles	3,550	4,030	4,470	4,810
Reserve fuel, lb	16,500	16,680	17,180	16,800
Cost per aircraft mile, $/st. mile	1.54	1.72	1.93	1.835
Cost per seat mile, cents/seat mile	1.26	1.41	1.46	1.39
Level flight speed (max cruise thrust)				
(a) 30,000ft at 220,000 lb, m.p.h. T.A.S.	561	586	586	582
(b) 30,000ft at 200,000 lb, m.p.h. T.A.S.	568	—	—	—
C.A.A. field length for T.O. at max T.O. weight, ft	9,440	8,640	8,760	9,000
C.A.A. field length for landing at max. ldg. weight, ft	6,680	6,630	6,690	6,690
Range with 6,500ft T.O. field length, st. m	1,830	2,650	3,060	3,280
Tourist (144 passengers all versions)				
Capacity payload space limited, lb	37,910	37,910	37,910	37,910
Cargo, lb	14,150	14,150	14,150	14,150
Range, st. miles	3,290	3,790	4,330	4,670
Cost per seat-mile, cents	1.07	1.19	1.34	1.27
Range with 6,500ft T.O. field length, st. miles	1,770	2,495	2,960	3,190

Applicable to all Models:— * Advanced rating

Wing area	2,758 sq ft
Wing span	139ft 8in
Overall length	148ft 10in
Overall height	42ft 4in
Wing sweepback at 25 per cent chord	30 deg
Landing gear type (swivel castor)	dual tandem
Turning radius (for wing-tip clearance)	91ft 1in
Lower cargo compartments (two): Total volume (both compartments)	1,445 cu ft

An order from Delta Air Lines announced on February 17th for six DC-8s of the domestic version (engine unspecified) brings to 110 the number of DC-8s now sold as follows: PanAm 25, United 30, National 6, K.L.M. 8, Eastern 18, J.A.L. 4, S.A.S. 7, Panagra 4, Swissair 2. The Boeing 707 score to date is 80, as follows: PanAm 20, American 30, Braniff 5, Continental 4, Air France 10, Sabena 3, T.W.A. 8.

STEEL FOR JAVELINS

OWING to delays in obtaining steel in Britain and to the need for maintaining a fast output of Javelin all-weather fighters, the Gloster Aircraft Co., Ltd., investigated the supply position in several European countries. As the outcome, an initial order to the value of £25,000 has been placed by the company with the Société Anonyme Usines Emile Henricot, of Court St. Etienne, Belgium, for about a hundred tons of high-grade steel to varied specifications.

Belgium was chosen because of the speedy deliveries offered and also because that country has been one of Gloster's best customers in post-war years (the Javelin is being considered as a likely night fighter for the Belgian Air Force in replacement of the Meteor). Delivery of this Belgian steel will begin shortly and continue for some twelve months.

The first Javelins are now being delivered to the R.A.F. after more than 2,000 hours of development flying and within the financial year for which they were ordered.

CHEAPER TITANIUM

RECENTLY, Imperial Chemical Industries announced a reduction in the price of their raw titanium to about 21s (just under $3) per lb. In the United States—the largest producer and user of raw titanium—the current price is $3.45 (a little less than 25s).

Some twelve companies have so far entered the field of raw-titanium production on a large scale, and there has been considerable competition to lower prices by means of improved extraction techniques. Two years ago the American price of first-grade material was $5 per lb (nearly 36s).

In August, 1953, I.C.I. announced plans to produce 1,500 tons of titanium annually by a new sodium process. The plant came into operation less than two years later. Instead of the coke-like "sponge" of the conventional Kroll process, titanium produced by the sodium technique is in the form of small granules which can be pelleted with alloying materials, thus facilitating the difficult process of melting.

Unfamiliar markings: The Hunting Percival Provost T.52 at top left has the old insignia of the Royal Rhodesian Air Force; to its right is a Fairchild C-119G of the Italian Air Force (46th Aerobrigata, based at Pisa). The Lockheed P2V-7 Neptune on the left belongs to the Japanese Self-Defense Force, and the Hunting Percival Pembroke above is the first of two for the Finnish Air Force.

AIRCRAFT INTELLIGENCE

Great Britain

Westland Whirlwind. Whirlwind helicopters now leaving the Westland line at Yeovil have the tail boom drooped through three degrees. The modification is of American origin and obviates damage to the tail boom by the blades flexing on touchdown. The pylon which carries the tail rotor is now at least double the length of the original in order to retain the same tail rotor characteristics.

U.S.A.

Convair F-102. There will be no squadron of Convair F-102 all-weather single-seat supersonic intercepters in service with the U.S.A.F. before July. Thereafter four more should be added by the end of the year.

Grumman Albatross SA-16B. This is a new development of the Albatross with a wing span increased by 16.5ft and having cambered leading edges for improved control at low speeds and at high angles of attack. Other improvements include larger ailerons with geared tabs, larger tail surfaces, and improved de-icing arrangements. Gross weight has risen by about 1,000 lb.

Boeing KC-135. Three squadrons of these Boeing jet transports will be able to do the same amount of work as fifteen squadrons—totalling 150 of the largest piston-engined transports—now being used by the Military Air Transport Service. Thus, thousands fewer men will be required in the way of aircrew and ground crew, fewer hangars, fewer spare engines and parts, fewer transport stops, and fewer crew quarters. According to Boeing vice-president Edward C. Wells, savings in direct operating costs in one year could total more than $40 million.

Martin XP6M-1 SeaMaster. The U.S. Navy has accepted a Martin proposal to delay flight tests of the second SeaMaster pending installation of test equipment of the type lost aboard the first machine. Unlike the first SeaMaster, which completed more than 50 hours in the air between July 14th and December 7th last, the second specimen carries complete mine-laying and navigation systems, which will now have to be removed to make room for the test equipment. The cause of the accident to the first machine has not yet been determined.

Republic F-105A. Notwithstanding previous reports, it is officially confirmed that this supersonic fighter/bomber, which made its first flight on October 22nd last, is powered with a Pratt and Whitney J57 turbojet. The F-105A has short-span, thin, swept-back wings, and a long cylindrical fuselage. Wing-root intakes permit radar equipment to be installed in the needle nose of the fuselage. The slab tailplane is set low on the after fuselage and there is a ventral fin surface.

Lockheed WV-2. A £25 million order from the U.S. Navy is announced for Lockheed WV-2 early-warning Super Constellations. Production will extend until December 1957. Lockheed engineers have calculated that a WV-2, flying at 10,000ft, could provide radar coverage over a surface area of about 45,000 square nautical miles.

France

S.O.4050 Vautour. The Vautour "04"—an all-weather fighter prototype—has been flying from Mont-de-Marsan in very bleak weather, including snow blizzards, and landing in cross winds on icy runways without using the braking parachute. Several flights have been made daily with this machine, as with another prototype which is being used for missile trials. This second machine has been engaged also on bombing and gunnery tests and it is stated that no difficulties have been met in firing the four 30 mm guns.

Leduc 021. The two Leduc 021 ramjet prototypes have now completed more than 90 flights, averaging three to four per week. Current tests are aimed at determining operational characteristics of the equipment to be installed in the 022 fighter.

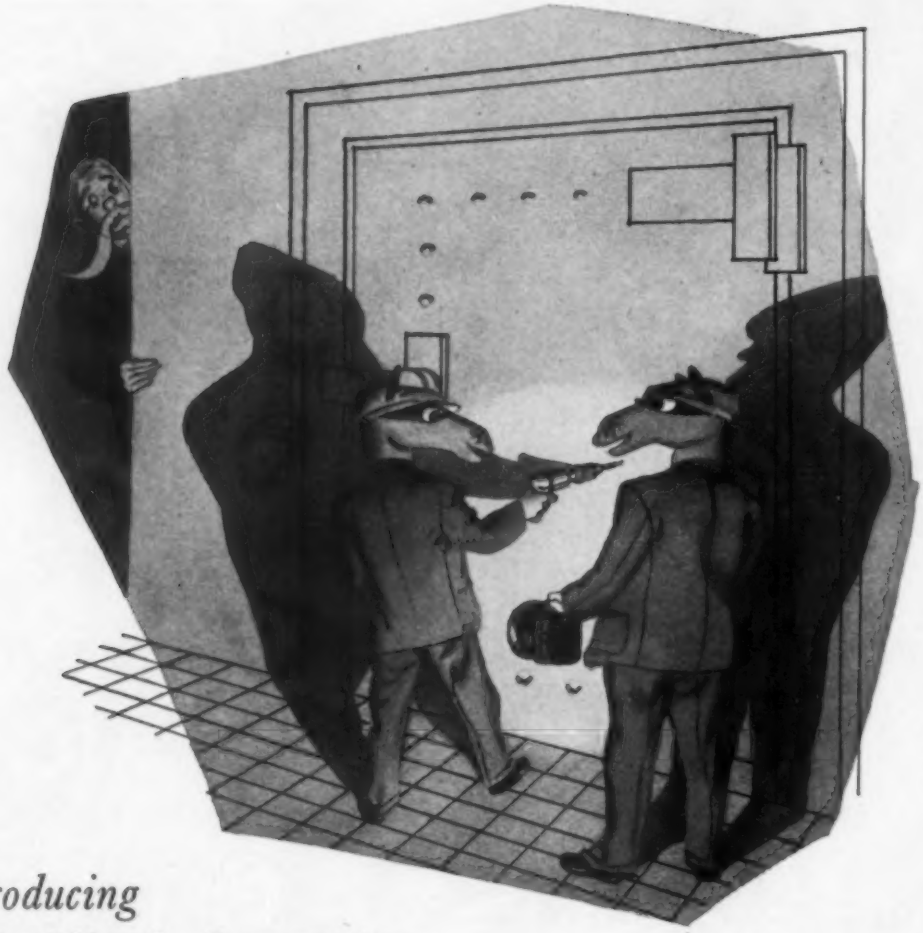
S.E.210 Caravelle. The prototype Caravelle has now accumulated over 329 hours in the air, representing 165 flights. Twenty-five Air France technicians have recently begun a training course to prepare the crews who are to conduct the 500 hours of endurance tests scheduled to begin in April. At the end of that month the second Caravelle should fly.

S.E. Thunderstreak Overhaul. For the U.S.A.F. in Europe and for the French Air Force, S.N.C.A.S.E. have so far overhauled 122 Republic F-84F Thunderstreak fighter/bombers. This work is done at the Marignane factory.

S.E. 3130 Alouette II. Two prototypes and three production models of the S.E. Alouette II helicopter are flying. After a few minor modifications one of these will be taken through the first 500 hours of endurance testing.

Fouga CM.170R Magister. Recent tests carried out with the Magister light jet trainer at Mont-de-Marsan have involved a number of student pilots whose aptitude "did not exceed a certain average degree." The students were divided into two groups, one doing its initial training on airscrew-driven machines and then converting on to the CM.170R, and the second starting immediately on the CM.170R. It was found that the average number of flying hours required by each group "to be proficient in solo flight" were: Group I, 40 hr on airscrew-driven aircraft, 10 hr on the CM.170R; Group II, a total of 20 hr on the CM.170R.

Where landing is impossible
the Helicopter is invaluable.
But when the "Sycamore" lands
it does so on a British Messier Undercarriage.



Introducing

'Raffles' Desoutter

People who make safes do so with the idea of frustrating burglars who want to bore their way in. Aircraft Designers appear to have much the same intention towards the long-suffering engineers who have to make and assemble their designs. Take Titanium for instance. (All right, *don't* take it! But if you have to drill holes in an Aircraft Factory you have no choice). Normal high speed power tools work themselves and their operators into a state of great heat, blunt edges and even blunter words. Enter 'Raffles' Desoutter, the Little Horse who works at speeds from 160 to 300 r.p.m. and will bore his way into the Bank of England. He is available in an increasing range of Desoutter Tools.

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CBC. 271

ENTERPRISE IN AIRSCREWS

First Details of a Mighty New de Havilland Airscrew and the Story of 21 Years of Achievement

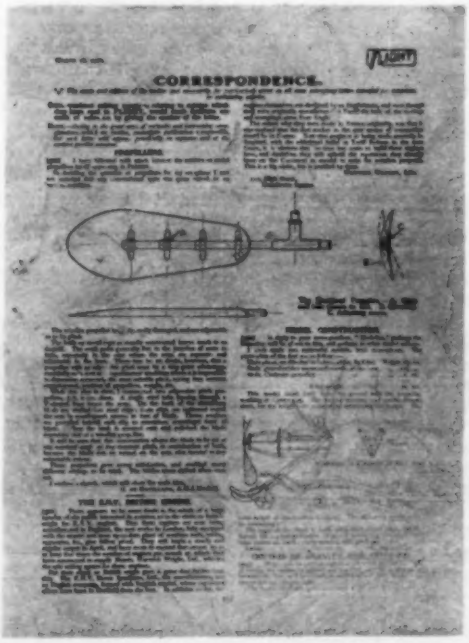
IN *Flight* for March 12th, 1910, we published a letter from a youthful and promising aeronaut named Geoffrey de Havilland. In it he discussed his design for a variable-pitch propeller: "There can be no doubt," he wrote, "that a propeller with an adjustable pitch must be a very great advantage . . . "

We recall how, at that time, the young de Havilland was experimenting with his first flying machine, which he successfully flew in the summer of 1910. The only part of it that survives is its propeller, a 5ft affair beautifully worked from solid spruce, which today presides in the de Havilland museum at Hatfield. It was in fact of fixed pitch—although the very first de Havilland aeroplane (which failed on its first attempted flight in December 1908) had two propellers which, as described by "D.H." in his letter, "were adjustable as to pitch and twist."

We asked Sir Geoffrey de Havilland to add a 1956 postscript to his letter of 1910. He says: "We knew so little in those days about optimum blade-angles, engine speed and so forth that I devised this propeller to enable me to select the best angle by trial and error. We just ran up the engine on the ground with different blade angle settings to see which gave the best results on a spring balance! It sounds comical now, but we were very proud of it then. We designed the propeller of the second aeroplane with fixed pitch, as we knew more of the game then."

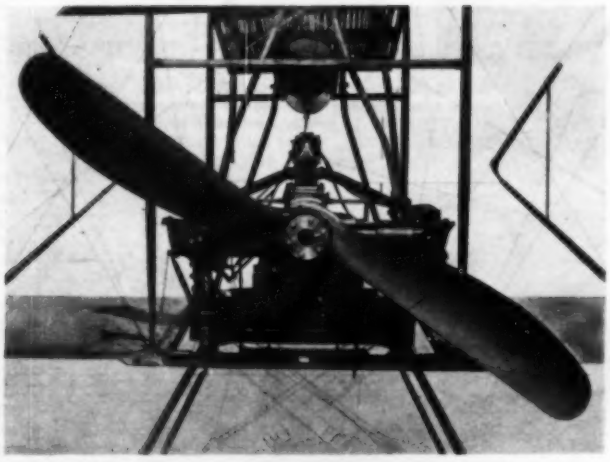
[*Continued overleaf*

Advance of the airscrew: the first published impression of the new de Havilland airscrew, now being designed for the 500 m.p.h. airliners of the 1960s. It represents an advance in the art of the airscrew as significant as was the introduction of variable pitch a quarter-century ago.



CORRESPONDENCE.

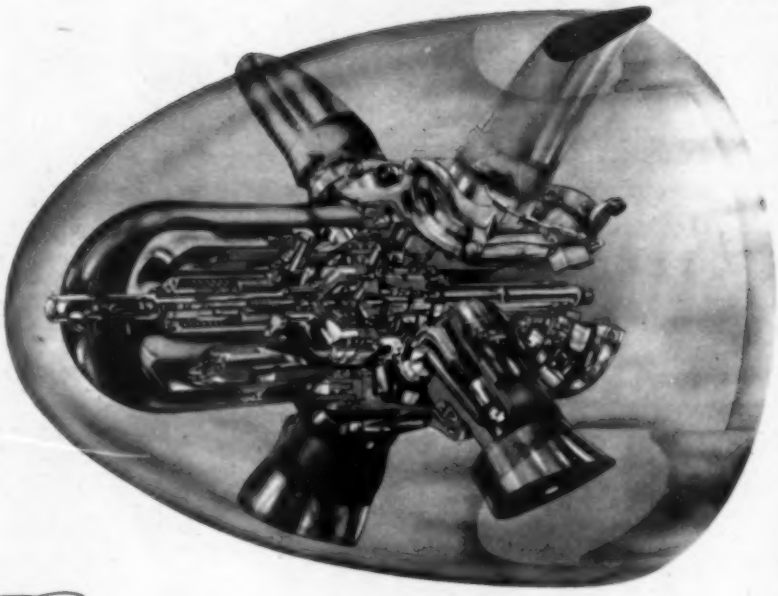
Flashback to the correspondence page of our issue for March 12th, 1910—the youthful Geoffrey de Havilland describes his design for a propeller with adjustable pitch.



The de Havilland propeller of 1910. This picture, which we believe has never been previously published, shows it installed on the first de Havilland aeroplane ever to fly. Note the engine: with four cylinders, horizontally opposed, it developed 45 h.p., and—like aircraft and propeller—was of entirely de Havilland design.

ENTERPRISE IN AIRSCREWS . . .

Right, "an accomplished and versatile work of engineering": a sectioned illustration of a typical contemporary de Havilland airscrew—the four-blade unit of the Ambassador. Figs. 1 and 2 below clarify the pitch-range of an airscrew blade, and the basic D.H. pitch-change mechanism.



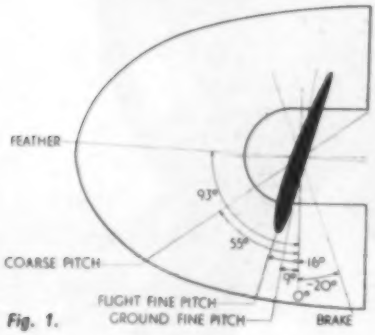
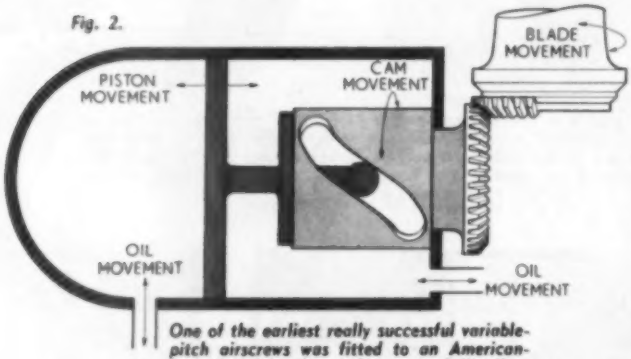


Fig. 1.

Fig. 2.



One of the earliest really successful variable-pitch airscrews was fitted to an American-built D.H.4 by the predecessors of Hamilton Standard, in 1926. It had metal blades and was capable of reversing.

Probably one of the earliest references to a propeller with variable pitch was by a contributor to the French International Bulletin of Aerial Navigation in 1871, who, after a ponderous preamble concerning the mechanics of the flight of the hen, outlined an ingenious idea for an hydraulically operated variable-pitch propeller. It was during the First World War that the advantages of variable pitch in flight ("to provide the aeroplane with a gearbox") were foreseen, and in 1918 the American N.A.C.A. invited engineers to "give their attention to . . . an airscrew . . . which will enable an engine to maintain constant speed at all altitudes." Although experiments in Britain (particularly at the Royal Aircraft Establishment in 1916, and in the 1920s with the Gloster Hele-Shaw-Beacham airscrew) gave promising results, the first really successful controllable-pitch airscrew was made in 1926 by the forerunners of Hamilton Standard of America, and tested at Dayton, Ohio, on a U.S.-built de Havilland D.H.4. It had metal blades and was capable of reversing; an earlier, unsuccessful version, probably with wooden blades, had been tested in 1920.

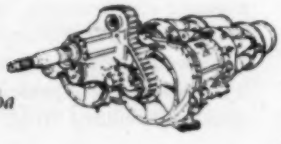
In 1927 Mr. Charles Walker—then, as now, chief engineer of the de Havilland Aircraft Company—contributed an article to Flight (our issue of January 27th, 1927) entitled *The Climbing Efficiency of Aircraft*. In it he argued the case for the variable-pitch propeller, showing that very often, with unsuitable blade angles holding down revs, only half an engine's horsepower was being converted into useful work on take-off, and that a rate of climb of 500ft/min could be raised to 900ft/min by using variable pitch. The results of that article were probably far-reaching. It was reprinted by the American *N.A.C.A. Bulletin*, and undoubtedly gave impetus to the development of v.p. airscrews in the U.S.A. At that time D.H. could not afford to embark on such a costly venture, and so it was, a few years later, when the variable-pitch propeller became essential to further progress, that

search–

strike!

TARGET AHEAD and the range closing. The hunt is nearly over as the Gannet comes in for the kill. Long range and new radar have combined to find and fix the enemy. High speed, manoeuvrability and unrivalled field of view, combined with the most formidable modern weapons, enable the Gannet to strike, and keep on striking until the enemy is destroyed.

Powered by the Armstrong Siddeley Double Mamba



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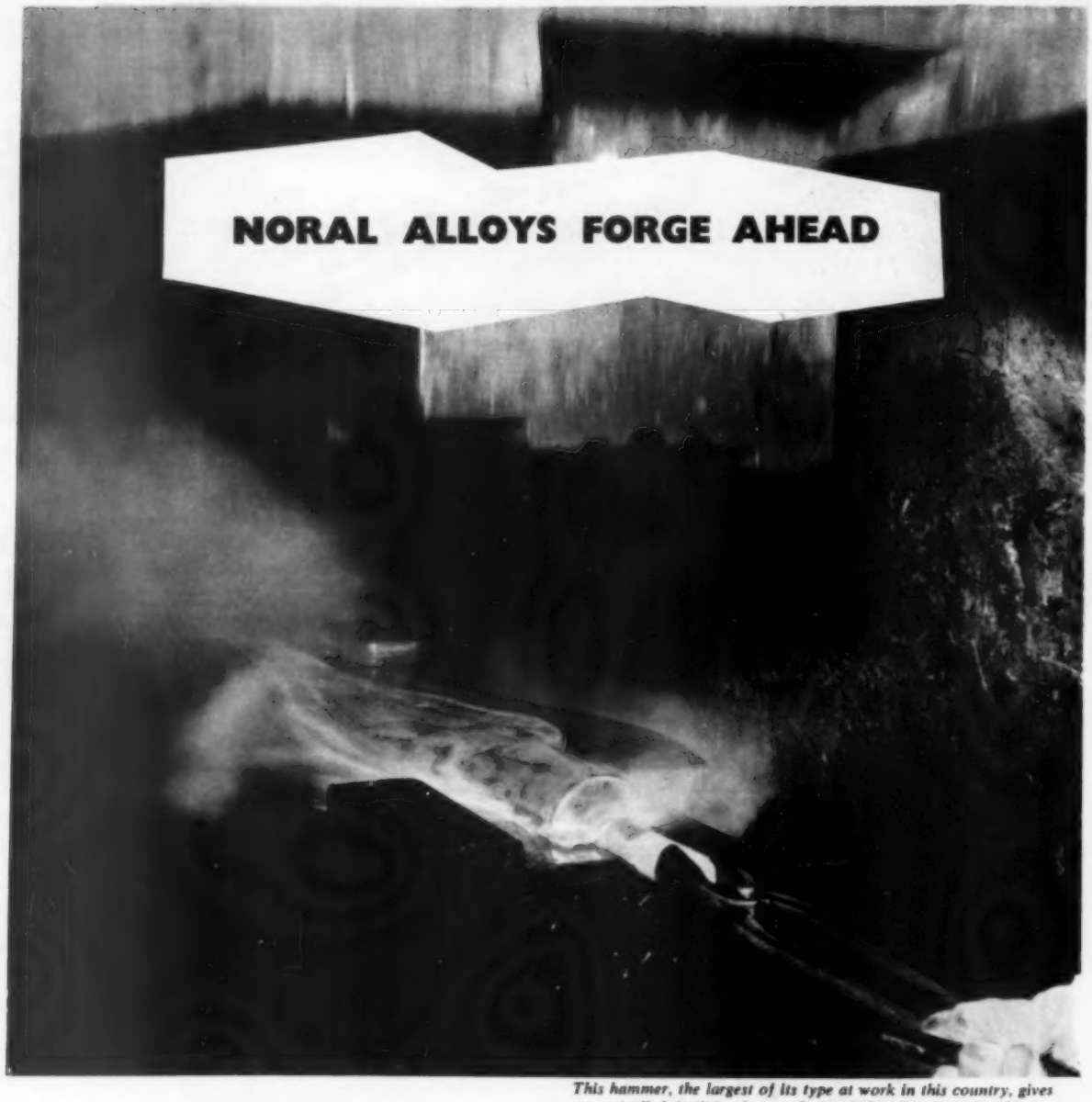

This hammer, the largest of its type at work in this country, gives us unrivalled facilities for producing light alloy propeller blades.

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ENTERPRISE IN AIRSCREWS . . .

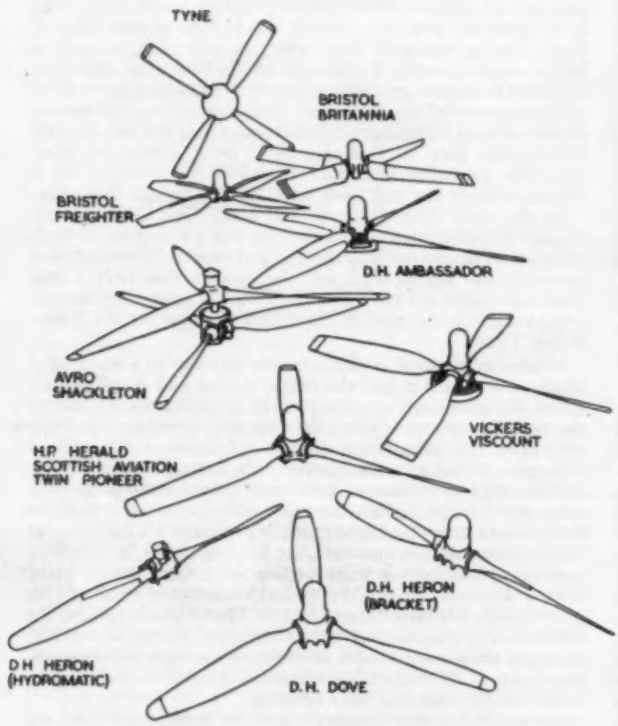
D.H. drew upon American experience. But more of this in a moment. What of the airscrew today?

The airscrew is a sort of aeronautical Cinderella whose true qualities are often taken for granted. There was a time, even after it had outgrown the "twisted plank" formula of its youth and had assumed the more mature responsibilities of constant-speeding, when the airscrew was an accessory supplied in the right size from stock, splined to an engine, and left to get on with the job of converting shaft horsepower into thrust. Certainly this will always be its primary function; but more and more in recent years, and particularly since the turbine changed everything, the airscrew has been called upon to do jobs which—if there were a thrust-producers' trade union—it could decline as being outside its sphere. We quote from the specification, a typical one, of a new de Havilland airscrew: "It shall be provided with reversing, automatic pitch-coarsening, synchronising, synchrophasing . . ."

The modern airscrew is an accomplished and versatile work of engineering which, as well as performing its primary job efficiently, carries big responsibilities for the engine and airframe as well. Reversing is only one example of how the airscrew is enlisted to improve aircraft performance. Auto pitch-coarsening is another: at take-off the ability to maintain performance after engine failure often depends on the airscrew's ability to coarsen pitch automatically, so that sudden uncontrollable windmilling drag is immediately relieved. Again, a recent refinement, inelegantly termed synchrophazing (a development of auto-synchronization), eliminates vibration and "beat" by ensuring that the blades of each airscrew move in a fixed angular relationship to each other, like the connecting rods of a locomotive. The effect of synchrophazing is to make all the airscrews turn at the same speed and angular position. In the words of a Hamilton engineer: "If you were to put a gear train between the propellers it would never transmit any torque."

Feathering was one of the airscrew's earliest accomplishments, and will always be regarded as the most important of flying safety features. Less well known, because it is a more recent innovation, is the pitch lock. This comes into operation in the event of failure in the airscrew's oil supply, locking the pitch at the blade angle obtaining at the moment of failure. The incorporation of such a system prevents the excessive windmilling drag and a possible overspeed which would result from the blades fining-off at high speed under the action of aerodynamic and centrifugal twisting moments.

The airscrew's biggest responsibility, however, is constant-speeding, which ensures that the engine operates always at its selected r.p.m. regardless of power or the flight condition of the aircraft. The means by which it is achieved varies between one design and another, but the basic principle remains the same. We have previously described the de Havilland-Hamilton formula of Hydromatic control (*Flight*



Family group: the entire range of de Havilland airscrews, united for "Flight" at the company's factory at Stevenage (key above).

Hollow-steel blade de Havilland airscrews, a distinctive feature of the Bristol Britannia, predominate in this fine winter's morning study of B.O.A.C.'s first two Mk 100s outside the Corporation's maintenance base at London Airport.

ENTERPRISE IN AIRSCREWS . . .

for November 2nd to 23rd, 1944) but a brief recapitulation will provide a useful preface to a description of the new D.H. airscrew.

The key unit is the constant speed controller, or governor, mounted on the engine. A gear pump in the unit takes oil from the engine and delivers it to an hydraulic valve, the setting of which is determined by centrifugal fly-weights whose position is governed by engine speed. This valve distributes oil *via* a rotating transfer bearing within the hollow engine shaft to the blade pitch-change mechanism in the hub. This mechanism (Fig. 1) selects coarse or fine pitch (Fig. 2), so either increasing or decreasing the airscrew's resistance to rotation. Coarse pitch results when oil is delivered to the front of the piston (Fig. 2), and *vice versa*. The fore-and-aft movement of the piston is converted into rotation of the blades by rollers which run in the slots of two concentric cam rings, one fixed and the other—gear-meshed to the blade root—free to rotate. Thus any change in r.p.m. triggers off a sequence of events which instantly restores the selected value. This value is of course determined by the position of the pilot's r.p.m. control lever, which alters the datum setting of the flyweights.

Blades are, in both senses of the word, the most absorbing part of the airscrew. Many and varied are the plan-forms chosen—rounded tips, square tips, tapered chords, parallel-sided chords, and variations too many to recount. The plan-form eventually chosen is, needless to say, a delicate compromise between available diameter (the fundamental design parameter) and weight. A discussion of all the factors which eventually decide plan-form and section is outside the scope of this article, but a brief commentary is pertinent. As powers increased during the 1939-45 war there was a steady tendency towards increasing the number of blades to provide the required solidity for absorption. Four-bladers began to replace three-bladers on high-performance fighters; even a five-blader saw service, and six-blade counter-rotaters were not uncommon. A further tendency, as higher powers had to be dealt with for the same diameter and r.p.m., has been for the predominant blade area to move towards the tips, where it can do more useful work. This trend has been most noticeable since the war, especially on turbine installations, where take-off is the critical condition. Since cruising r.p.m. of a turbine are a much higher proportion of take-off r.p.m. than is the case with a piston engine, take-off r.p.m. have to be kept comparatively low too in order to keep cruising tip-speed, and therefore noise, at an acceptable level. Hence broader blades to restore take-off performance.

Hollow steel blades are considered by de Havillands essential for big airscrews required to handle 4,000 h.p. and above; and, indeed, without them further progress would be barred. D.H. were the pioneers outside the U.S.A. of this type of blade, having foreseen soon after the war that, without a heavy weight penalty, Duralumin blades would be unable to provide the necessary stiffness for the big blades needed by the very powerful new turbines. The engineering and manufacture of steel blades (described by our sister journal *Aircraft Production*, July to August, 1951) is a matter of considerable ingenuity and skill: examples in operation on a British aircraft are the 16-ft units of the Bristol Britannia.

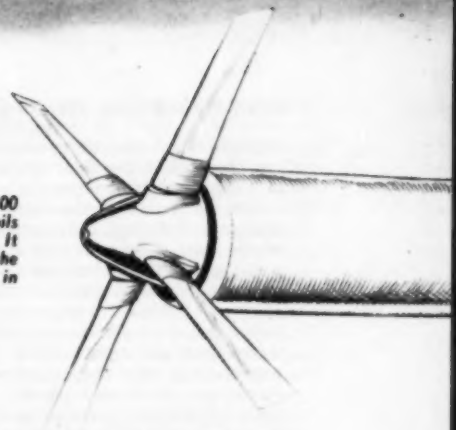
At the same time, however, the design and development of solid Duralumin-bladed airscrews has not lagged; in fact, progress in design and metallurgy, and especially in vibration research, has led to their use for powers that only a few years ago could not have been handled by light-alloy blades. (An example is the new de Havilland airscrew for the Rolls-Royce Tyne).

Vibration research is undoubtedly the key to a successful blade, and into it is put the major design and development effort. By artificially applying vibration to the blades, and to the hub also, inherent vibration and its unpleasant effects in operation are eliminated in the laboratory. The word "laboratory", with its associations of scholarly research in an environment of monastic quiet and seclusion, is perhaps a misnomer for the de Havilland vibration department at Hatfield, where electro-magnetic exciters pound all day long at blades, hubs, spiders and—such is the scope of D.H. vibration analysis nowadays—a wide variety of aircraft components from industry at large. We recently illustrated some of this work (*Flight* for November 11th, 1955) and observed that the controlled application of high-frequency vibration stresses occupies the greater part of an airscrew's design and development period, in which the paramount quest is for longer life, lower weight, and smoother running.

So much for the airscrew—and its background—as we know it today—a remarkable synthesis of design and engineering ingenuity. For nearly two decades the airscrew's charac-

ter and appearance have been essentially unaltered, despite astonishing increases in the powers it has had to harness and the control functions it has been called upon to perform. For many applications it will remain much the same for as far ahead as can be foreseen: but for high-speed flight a new formula is required. The reason is simply that, in order to absorb the very high take-off and cruising powers offered by the new turbines, and to achieve high flight speeds without noisy tip speeds, very wide blades are needed. A blade of conventional width trying to handle such large take-off powers finds sections of itself working at incidences above the stall, and stalled flutter can result, causing high torsional stresses. Wide chords effectively reduce incidence, and torsional stiffness can be preserved without too heavy a weight penalty by the use of hollow steel blades. But the larger the blade, the greater the centrifugal and aerodynamic twisting moments acting on it. In normal flight, with power on, centrifugal and aerodynamic twisting moments act in opposing senses, and are always tending to cancel each other out; but, if an engine suddenly loses power (or is throttled back) and the airscrew starts to windmill, the aerodynamic twisting moment changes sign. Unless opposed by the pitch-change mechanism the blades fine-off rapidly, causing engine overspeed, sudden asymmetric drag, and perhaps loss of control. Clearly, the higher the flight speed and the bigger the blades the greater the power required by the pitch-change mechanism to prevent them from fining-off in such circumstances.

More pitch-changing power requires either a larger mechanism, or—with a hydraulic system—a higher-pressure oil supply. A bigger mechanism is ruled out on the score of weight, engine-shaft bending moments, and bulk. The only answer lies in the use of higher oil pressures.



Another impression of the new "500 m.p.h." D.H. airscrew, first details of which are given in the text. It shows the blades feathered: in the illustration on p. 237 they are in the take-off position.

Bristol 187 airliners. It is for this engine that the new airscrew is intended. The initial version of the BE.25 of about 4,000 s.h.p., as ordered by B.O.A.C. for its Britannia fleet, will be fitted with airscrews which are substantially similar to the existing D.H. units for the Proteus.

The illustration on this page (another view is on page 237) shows an impression of the new airscrew as it will look installed on the BE.25 engine. The very wide blades are of the hollow steel variety having approximately constant chord, and have N.A.C.A. series 16 sections of very low thickness/chord ratio and camber. The airscrew is designed specifically for the cruise condition, and the blade sections are chosen to give satisfactory L/D ratios at the transonic relative speeds at which they must work in this condition. The illustration, which shows the airscrew blades in the feathered position, emphasizes the blade-root and spinner fairings necessary to preserve low thickness-chord ratio right down to the spinner surfaces; the fixed spinner fairings are designed to coincide with the blade in the design cruise condition to give maximum engine air intake efficiency. The circular intake at the spinner nose admits air to cool the closed hydraulic system of the propeller, in which considerable heat is continuously generated. It should be noted that although the airscrew is designed for cruising conditions, its take-off performance is entirely satisfactory owing to the great blade width necessary to absorb the cruising power of the BE.25 engine at altitude.

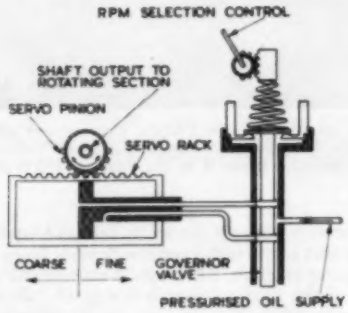


Fig. 1.

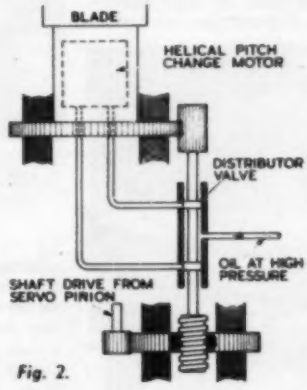


Fig. 2.

Sufficient pitch range is provided to permit full power-on reversing for landing-brake purposes. The control system will incorporate synchrophazing; and provision is made in the design for precise manual control of blade angle and therefore of thrust, whilst the engine is controlled by fuel flow at constant r.p.m., to facilitate manœuvring on the ground.

The hub consists of a rotating section carrying the blades and pitch-change mechanism and, to the rear, a section held stationary relative to the engine which houses the controller and other ancillary equipment. Each of the two sections has its own oil system, and control signals from the stationary controller are transmitted mechanically to the rotating pitch change mechanism by means of a differential gear system. Fig. 1 is a much simplified diagram of the control servo system in the stationary section of the hub; a small flyweight governor-valve meters oil at comparatively low pressure to a servo rack which consists of a cylinder sliding about a fixed piston. The position of the servo rack is determined by the

The conventional airscrew system in which oil is supplied from a controller mounted on the engine *via* a transfer bearing on the engine shaft has proved a convenient and efficient arrangement where operating pressures can be kept below about 800 lb/sq in. If airscrew operating pressure is increased beyond this value, however, an unacceptable leakage rate from the transfer bearing is experienced. The self-contained type of hydraulic airscrew, introduced some time ago by Hamilton Standard of America, eliminates the transfer bearing by including the entire oil system and control mechanism within the airscrew itself, so permitting the use of the higher working pressures demanded by the larger airscrews.

This system has been adopted by de Havilland to exploit to the full the potentialities of the new British turbine engines. Prominent among these is the Bristol BE.25, which in its developed form will power the 1960 family of 500 m.p.h.

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quantity of oil metered to one or the other side of the piston, and the rack is therefore analagous to the pitch change unit of a Hydromatic airscrew.

The servo rack meshes with a pinion, rotation of which is transmitted through differential gearing to the rotating section of the hub. The essentials of the control system within the rotating part of the hub are shown in Fig. 2. This is a high pressure hydraulic system receiving oil at operating pressure of up to 2,500 p.s.i. from pumps contained within the rotating hub and is controlled by the distributor valve. The rotational signal from the servo pinion via the differential gearing is converted to axial movement of the distributor valve by the screw jack mechanism shown in Fig. 2. Movement of the valve admits high pressure oil to a helical pitch-change motor located in each blade root, causing a change of blade angle in the desired direction. Movement of the blades, which are geared together in the actual airscrew, rotates the valve and restores it by means of the screw jack assembly to its neutral position when the change of pitch demanded by the original movement of the servo rack has been effected.

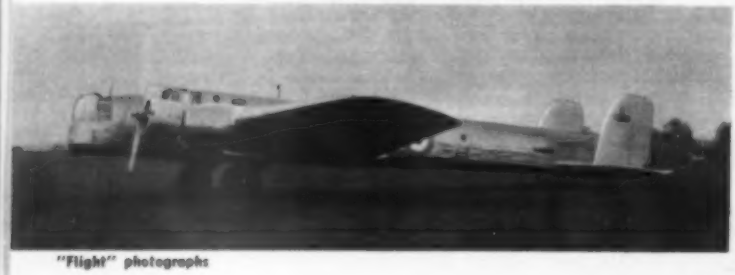
In this way any given position of the servo rack corresponds to a definite blade angle, and all the safety stops can therefore be incorporated mechanically in the servo rack mechanism. Since the servo rack is located in the stationary section of the hub, this avoids the necessity for mechanical stops in the rotating section: failure of the high pressure control system is catered for by the provision of a mechanical pitch lock consisting of two ratchet gears, one of which is attached to the bevel gear interconnecting the four blades, the other being coupled mechanically through the differential gearing to the servo pinion. If the actual relationship between the blade angle and servo rack position departs from normal by more than 2 deg of pitch, the ratchets engage and prevent any movement of the blades towards fine pitch. Feathering action can then be taken if necessary, an electrically driven pump being provided to take over when propeller rotation is no longer sufficient to generate the required hydraulic pressure.

Automatic pitch-coarsening, initiated by an electrical signal from the engine torquemeter, is provided to cater for the possibility of engine failure at take-off. As a protection against engine failure or throttling back during cruise, a similar separate system is provided.

Later this year de Havilland will have been 21 years in the airscrew business (not counting previous "one-off" designs such as the historic 1910 propeller). It was on July 30th, 1935, that the first controllable-pitch airscrew built by D.H. under Hamilton licence—a 12¼ft "5,000-size" three-blader for development work on the 1,000 h.p. Bristol Pegasus—was delivered from the D.H. engine factory at Stag Lane, Edgware. There were then 18 men and 12 machines. Two years later the propeller division of the de Havilland Aircraft Company was to become the largest airscrew organization in the world —out-producing even its Hamilton parent. So it was that in 1939 D.H. possessed the only full-scale airscrew manufacturing facilities in the country, and they went on to produce the major share of all airscrews used by the R.A.F. and the

The D.H. turbine airscrew for the Vickers Viscount—an alternative installation for the more powerful Dart 510-powered Viscount 700D series. The installation shown is on the Viscount 630 prototype.

Above, the forging of new D.H. history: the very first Duralumin blade-forging at Stag Lane in April, 1935. Below, the first D.H. airscrews to fly were fitted to the Armstrong Whitworth Whitley bomber prototype (two Armstrong Siddeley Tigers) which first flew on March 17th, 1936.



"Flight" photographs

Fleet Air Arm throughout the entire duration of the war.

The events leading up to the delivery of the first "5,000-size" airscrew in 1935 form a pioneering pattern familiar to students of D.H. history. In 1933, following a small advertisement in *Flight* offering a suitable aircraft design for entry in the following year's great England-to-Australia air race, D.H. got busy on the D.H.88 Comet long-range racer. A.E. Hagg was in charge of design, and he wanted v.p. airscrews. The only really developed design was found to be the Hamilton airscrew in the U.S.A., and—with the race only eight months away—Messrs. Hagg and Hearle went to America to investigate. The immediate result was that a pair of airscrews was acquired for testing on the D.H.88, which flew on September 8th, 1934, three weeks before the race. These having been designed for a radial engine, however, the blade-roots were too thick to permit efficient cooling of the in-line D.H. Gipsy Six R, and an alternative airscrew, a French Ratier (whose two-pitch mechanism was energized on the ground with a bicycle pump) was chosen. The Comet—the first British aircraft designed to have v.p. airscrews, wing flaps and retractable undercarriage—won the race.

The eventual result of that first visit to the U.S.A., however, was that D.H. decided to purchase a licence to build Hamilton airscrews, at a cost of about £20,000. This was a huge sum for the firm to find, and although orders from the Government were sought, none was forthcoming—there was just no official interest in v.p. airscrews for military aircraft. The support of other aircraft firms could not be enlisted, and D.H. decided to go ahead on their own. "You people are asking for trouble," Mr. Walker remembers a director of a British engine firm saying to him at the time.

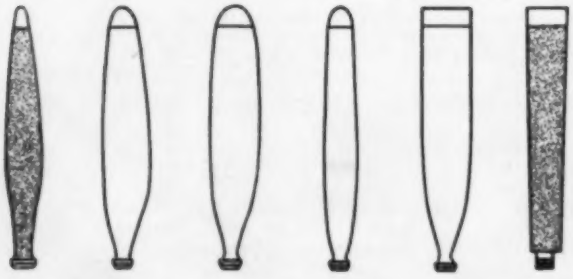
Licence negotiations were completed in June 1934. American drawings began to arrive at Stag Lane (they had to be converted for left-hand rotation) and a corner of the Stag Lane engine factory was set aside for the hand-machining of blades out of solid Duralumin billets. The very first order was received—a contract from the Air Ministry for five "5,000-size" three-bladers (four left-handers for the Bristol Pegasus and the Armstrong Siddeley Tiger and one right-hander for the Rolls-Royce Merlin) for development tests. There were—as D.H. had expected—unknown manufacturing difficulties, including a problem that seemed almost incapable of solution at one stage: this was the elimination of forging "laps," which showed up when the finished hand-polished blade was put into the anodising bath. The laps resembled fish-scales, and old hands recall the foreman's habit of going round with his penknife, querulously prising them up; he was eventually presented with a mock penkife of huge dimensions, but not before the problem had been solved.

The first airscrew was completed and delivered to Bristol on July 30th, 1935, for test-running on the Pegasus (it had spent the previous month being spin-tested at the R.A.E.). Bristol soon had a Vickers Vildebeest and a Bulldog, respectively fitted with a Pegasus and a Mercury, flying with D.H. "controllables", as they were then termed. It was at about this time that the first commercial order—indeed the first production contract—was received. This was from Shorts for eight airscrews for their "C"-class Empire flying boats.

The very first D.H. airscrews to fly were those installed on the prototype Armstrong Whitworth Whitley bomber (two Armstrong Siddeley Tiger engines) which, piloted by A.C. Campbell-Orde, made its maiden flight at Baginton aerodrome, Coventry, on March 17th, 1936. By then the rearmament programme was gathering momentum, and large production orders had been placed by the Air Ministry—including about 70 for the Whitley, 250 for the Fairey Battle, and hundreds more for the Hurricane, Spitfire, Defiant, Blenheim, Lysander, Wellington, Hampden and others. Stag Lane really began to hum, and by Christmas 1937 had built more than 2,000 airscrews. Then a big new factory at Lostock near Bolton, Lancashire, joined in, having been built in only nine months as part of the government's emergency pre-war shadow-factory programme. It soon became, as it is today, the main source of D.H. airscrews.

By the summer of 1937 half-a-dozen sizes of airscrew, from 7½ft to 14½ft, were available for engines from 130 h.p. to 1,700 h.p., each as two-pitch units or with constant speeding. It was a matter for subsequent regret—during the Battle of Britain, as we shall relate—that constant-speed airscrews had been specified by the Ministry mainly for twin-engined types, and two-pitch types for the single-engined fighters. This was probably a correct decision at the time: constant-speeding in those days was not 100 per cent reliable, and the chances of an oil leak, it was argued, would not be so impor-

Left, blade planforms (developed, and not to scale) of some typical D.H. airscrews—left to right: Blenheim, Dove, Apollo, Herald, Viscount, Britannia. The trend is towards increased chord to provide increased power-absorption without excessive diameter, and for greater area at the tips where more work can be done. Blades nearly a yard wide are foreseeable for the very large powers of the future. Right, constant-speed units—eight varieties are seen—are manufactured with clinical care to achieve the necessary sensitivity: tolerances are down to 0.0003in, and each component is washed and inspected eight times.



The most remarkable airscrew story of the war was D.H.'s emergency conversion—in 52 days—of 1,051 Spitfires, Hurricanes and Defiants to constant-speeding just before the Battle of Britain. When a contracts clerk seemed worried about payment arrangements, a D.H. engineer replied: "If it isn't done we may never live to be paid for anything." Below, one of the Mosquito's 40 variants which had D.H. airscrews.

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tant with engines positioned well away from the windscreen.

Commercial business also became brisk. The small two-blader "1,000-size" bracket-type, forerunner of today's Heron airscrew, was in demand for Percival's D.H. Gipsy-Six-powered types such as the Vega Gull, Mew Gull, Proctor, twin-engined Q-6, and also for the four-engined D.H. 86 Express airliner.

In 1936 the first export order was received—from Poland for the Jakimuik-designed P.Z.L.37 bomber (two Bristol Pegasus). There followed orders from Holland for the similarly powered Fokker T.5 bomber and D.21 fighter (Bristol Mercury), and deliveries were made also to Turkey, Sweden, Belgium and Yugoslavia. It was the beginning of a demand which to date has established D.H. airscrews in 71 countries.

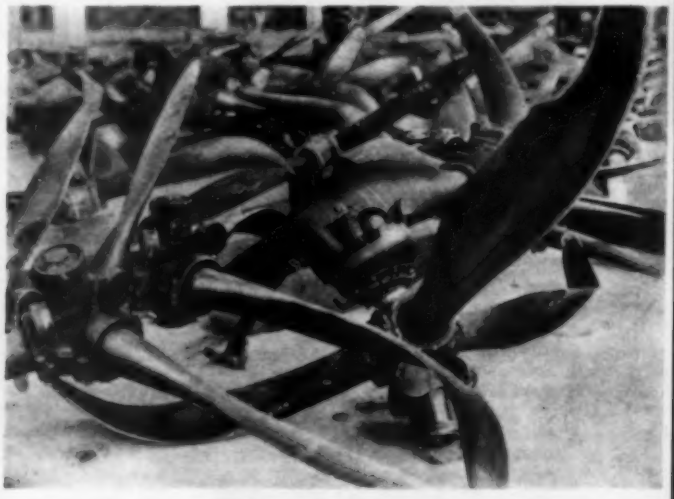
By September 1939 the D.H. airscrew division had in its first four years delivered 10,000 propellers, and it was ready for an immediate expansion to meet the demands of war. The subsequent effort speaks for itself: the output up to 1945 accounted for more than 100,000 new airscrews manufactured, nearly 38,000 assembled from American parts, and more than 40,000 repaired after war damage. The peak was reached in June, 1944—around D-Day—when about 1,300 units a week

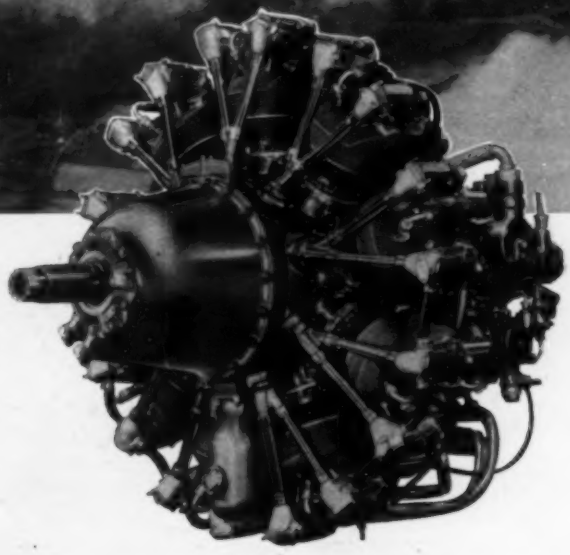
were leaving D.H. factories, including D.H. Australia, who had started production a year before Pearl Harbour and, like the parent company, had found themselves prepared for war.

But the greatest wartime accomplishment of all, without which the result of the Battle of Britain might have been reversed, was the conversion to constant-speeding of Fighter

The "1,000-size" D.H. airscrew, seen here on a Percival Vega Gull in 1936, has remained virtually the same for 20 years: it is to be seen today on the Heron. (Right) Not for the graveyard: thanks to the ductility of the Dural blade, more than 40,000 war-wounded airscrews were repaired by de Havilland between 1939 and 1945.

"Flight" photograph





The Hunting Percival Pembroke is powered by Alvis Leonides Engines

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40,000 ft. apart

Squadron Leader J. S. Fifield, D.F.C., A.F.C., by a recent successful ejection at ground level, demonstrated the capability of the latest Martin-Baker fully automatic ejection seat to bring about safe escapes near the ground at low forward ejection speeds. A further important requirement of an ejection seat lies in its high altitude performance. Martin-Baker fully automatic ejection seats are designed to bring the seat occupant safely down from the ejected altitude, stabilised and under control, to a selected altitude at which parachute deployment and separation of the occupant from the seat is automatically performed.

The altitude of the live ejection demonstrated at Chalgrove on October 25th was over 40,000 feet, and the altitude of separation 10,000 feet.

Martin-Baker

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Command's Hurricanes and Spitfires in 1940. This work was done by D.H. engineers at R.A.F. stations in between sorties: 1,051 aircraft were converted between June 25th and August 16th, an average of 20 a day. It was a few days after Dunkirk that an engineer officer at an R.A.F. station had telephoned Hatfield to ask whether a Spitfire could be converted to constant-speed, as R.A.F. fighter pilots were finding that they were being outflown by Me109s with their V.D.M. multi-pitch airscrews. The Spitfire conversion was completed a few nights later, the aircraft tested and found far superior —particularly in its rate of climb and ceiling—and work began in earnest. Production of constant-speed-units was stepped up; D.H. engineers, in their brief appearances at Stag Lane during the next few weeks of day and night work in the field, are remembered best for the length of their beards and the bleariness of their eyes.

Airscrew development 1939-45 provides a story typical of the way in which war accelerates technical progress. A brief account of the main achievements is an essential preface to the post-war story.

Until 1940 very little original airscrew development work had been undertaken, the main effort being devoted entirely to the production of Hamilton designs. Some of these were, of course, modified to British requirements—several of them quite extensively (a new size of hub was provided for the Hercules engines in the new range of 1939 heavy bombers). The nucleus of a technical department had been formed; at the outbreak of war there were quite a few technicians engaged on vibration and aerodynamic problems. It was, in fact, vibration analysis that led to the formation of the original technical department, which was to become the pioneer of strain-gauging techniques in Britain. Taking American experience as its background, the D.H. vibration department was soon to have no small influence on aviation in this country. The vibration measurement of airscrews in flight—a strain-gauged unit first flew in December 1941—was invaluable to engine manufacturers: two examples of changes made as a result of this experience were the firing order of the Griffon and the vibration dampers of the Hercules. The services and experience of the D.H. vibration department soon came to be drawn upon by the industry as a whole. On the aerodynamics side the R.83 report published by the company in 1941 became accepted as an important standard for the calculation of airscrew performance.

Great strides were being made in the design of Dural blades, particularly as more knowledge of stress concentrations were gained by vibration analysis. For instance, the 1939 thickness ratio at 0.7 radius was 8.2 per cent, compared with 7.4 per cent in 1944. Likewise, root thicknesses, even more important because of engine cooling considerations, dropped from 67 per cent in 1939 to 36 per cent in 1944. Today 20 per cent is regarded as quite satisfactory from the stress point of view. The effect on airscrew weight is obvious.

The first four-bladers were flown in 1941 and in due course went into service on the Napier-Sabre-engined Typhoon. Oil-slinging difficulties were experienced at first, necessitating the improvement of blade-root seals, and modified four-bladers eventually saw fairly wide service on Typhoons, Tempests, and special P.R. Mosquitoes. They were scheduled for installation on the Stirling, Halifax and Wellingtons due

A late summer's day in 1940 draws to an end, and a Spitfire is serviced for the next day's Luftwaffe onslaught. Conversion of the Spitfire's D.H. airscrew to constant-speeding had been given priority in the weeks before the Battle of Britain.

The wartime scene in one of the D.H. airscrew factories, which built 100,000 new units during the war. Peak output rose to 1,300 a week in 1944.

Thrustful line-up: the Merlin-engined D.H. Hornet was for a decade the fastest (470 m.p.h.) airscrew-driven aircraft in service. It had what was surely the cleanest piston-engine installation of all time.

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to be powered by Hercules engines with turbo-blowers, which in the event never materialized.

The first D.H. counter-rotater was completed in September 1941 and flown in 1943 on the R.R.-Vulture-engined Tornado. It then seemed that the capacity of single-disc airscrews was going to be inadequate to meet the requirements of the bigger engines than envisaged. This view has, of course, changed since, and although counter-rotating airscrews are still in production and giving efficient service (for example on the Griffon-engined Shackleton) their weight and complexity are to their disadvantage from the development angle. But it is interesting to recall the original way in which the complicated design was tackled in 1941.

A new type of pitch-change mechanism was evolved by the D.H. designers, since the existing Hydromatic type could not be applied. Known as the rack-and-pinion design, it comprised a moving cylinder with racks which engaged with pinions on the blade roots of the front airscrew. The racks continued to the rear airscrew through a "translation unit", so that axial movement of the front racks was conveyed to the rear racks while at the same time a change in direction of rotation was achieved. There were many development difficulties, mainly with the translation unit, and although a smaller version developed for the Merlin was successful, counter-rotaters did not enter large-scale production. A contemporary rumour, incidentally, that crash landing a metal counter-rotater would result in the engine being torn out by the blades locking was scotched in August 1944, when a Spitfire being tested with a Griffon airscrew made a wheels-up landing at Hatfield and survived comparatively undamaged. It is interesting also that an experiment with a counter-rotater whose halves ran at slightly different r.p.m. (to avoid the blades passing when the same reduction-gear teeth were in mesh) was discarded owing to the resulting optical pattern of a steady rotating star which bothered pilots.

The rack-and-pinion design, however, was extended to single-disc airscrews, mainly for production reasons: the type could be made in about two-thirds of the man-hours required for the Hydromatic airscrew, and in 1942 difficulty in obtaining specialized American machine tools had hindered the expansion of Hydromatic production. The Merlin-engined Lancaster was one of the types for which the rack-and-pinion airscrew was intended, but production was postponed when large quantities of American-built Hydromatics suitable for the Lancaster became available under lease-lend. Production was later resumed for the Mosquito, but the rack and pinion eventually gave way in favour of the Hydromatic.

War-time development of reversing airscrews gave very promising results and prepared the way for their early application to civil aircraft after the war. The first tests were aimed at assessing the value of the airscrew as an airbrake; a promising pre-war experiment had been carried out with a de Havilland Don trainer (Gipsyking) whose airscrew blades were allowed to windmill in fine pitch for braking in fast dives. A similar test made with a Spitfire in 1940 was promising enough to encourage D.H. to extend the trials to include actual reverse-pitch landing. The pitch settings were altered and landing tests made at Hatfield; there was, however, a tendency for the aircraft to swing violently when the throttle was opened in reverse pitch. The expectation that this would not occur on a tricycle-undercarriage aircraft was confirmed during subsequent tests with an Albemarle. The way was clear for development of a reversing airscrew for the first de Havilland post-war aircraft, the Dove, and it was this unit that gained the first British type-approval for equipment of this kind (March 1947).

At the end of the war the de Havilland propeller division was still a part of the parent Aircraft Company, but it was clear that its size and specialized responsibilities called for the formation of a separate company. Thus de Havilland Propellers, Ltd., was incorporated on April 27th, 1946, with the main headquarters at Hatfield as the centre of design, development and flight-testing, and with the main production plant at Lostock in Lancashire. By then D.H. had airscrews prepared for the abundant crop of new British post-war airliners—de Havilland Dove, Bristol Wayfarer/Freighter, Avro Tudor, Handley Page Hermes, Airspeed Ambassador, Vickers Viking, Percival Prince, Miles Marathon, etc., and procured production orders for the majority of these types. Although not the first to get a turbine propeller flying—Rotol, always the keenest competitor to de Havilland, were on the famous Trent-Meteor in 1945—D.H. were the first to secure an A.R.B. type-approval. This was in December 1946, when a 13ft Hydromatic airscrew successfully completed a 100-hour type-test on the h.p. Bristol Theseus.

Installed in place of the outboard Merlins of a Lincoln, they flew for the first time on February 17th, 1947, an historic date in the development of de Havilland turbine propellers. It is in this field that almost the entire post-war airscrew design and development effort has been conducted: radical new thinking was required to master the special control problems of the turbine, and long-term planning was essential to ensure that the airscrew kept abreast of the turbine, which was—as it still is—always pressing on at a startling pace. Experimental facilities at Hatfield were expanded, and the end of 1946 saw the completion of twin 22ft test tunnels, each 200ft in length, for the full-scale testing of airscrew and powerplant.

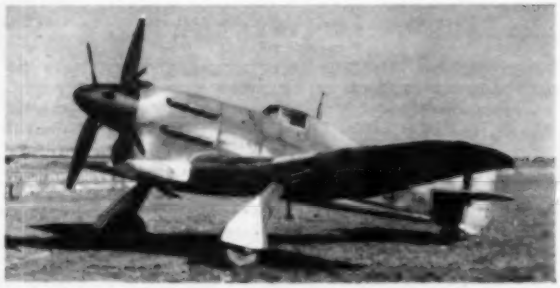
The foremost problem was to provide governors to handle the rapid power build-up that characterizes the turbine, while at the same time introducing a measure of anticipation into the system to allow for the initial delays in response to throttle. Higher-capacity governors, with anything up to double the rate of oil flow, were necessary to deal with the required high rates of pitch-change. The airscrew designer found himself working more and more closely with the engine man, tackling the handling and controlling problems of the more sensitive turbine together, and at an early stage. Reversing, particu-

larly on solid-shaft turbines—i.e., those on which the turbine is not coupled mechanically to the compressor—posed special difficulties of surging and excessive jet-pipe temperatures. The problem was finally solved by a system of "governing in reverse", successfully tested for the first time on the Mamba-powered Marathon on July 23rd, 1951. The airscrew concerned was incidentally the first *turbine* unit to be type-approved with the reversing feature. Safety requirements for the turbine were more stringent, because of its very low motoring power and suspectibility to run away in the event of engine or control failure. Automatic pitch-coarsening and the pitch lock, discussed earlier, were introduced to take care of the aircraft on take-off or while cruising.

A major achievement in 1951 was the completion of the biggest turbine airscrew ever made: this was the 16½ft eight bladed counter-rotater for the coupled 7,000 h.p. Proteus turbines of the Saunders-Roe Princess flying-boat. Four were fitted, plus single-disc units on each outboard single Proteus (reversible for water-manœuvring) and they were conspicuously successful throughout the all-too-brief trials of the great ship in 1952 and 1953.

In 1949 de Havilland had begun to study possible designs of an airscrew to suit the Bristol Proteus 3,000/4,000 turbine, then being designed as the powerplant for a great new airliner that was to materialize as the Britannia. The initial studies led to the decision to employ hollow steel blades, for reasons already discussed, and production by the already proven Hamilton technique began in 1950. The airscrew design evolved, with its four square-tipped, constant-chord blades, has since become a familiar characteristic of the Britannia.

The first departure from the exclusive business of producing airscrews took place in about 1950, when small-scale manufacture of electronic vibration-measuring equipment



A rare picture of the D.H. counter-rotater designed for the Vulture-engined Tornado, flight-tested in 1943. It did not see operational service, but showed the way towards post-war counter-rotaters.

IDENTITY PARADE

The pages of this article include illustrations of some of the 200 or more aircraft which have been fitted with D.H. airscrews since 1936. They are as follows (not in strict chronological order):—

P.238 (top): Whitley, Leopard Moth, Bulldog, Harrow, Hendy Heck, Vildebeest, A.W.23, Don, Phoenix. **Bottom:** Bristol 148, P.Z.L. Sum, T.K.4, Mew Gull, Ikarus II, He 70, Wellesley, Bristol 146, Vickers Venom.

P.239 (top): D.H. 86, Britain First, Dragonfly, Hobby, Mentor, Vega Gull, A.W. P.27/32, R.W.D.15, Dragon Rapide. **Bottom:** Double Eagle, Golden Hind, Mercury-Hind, F.K.43, Gladiator, Moth Minor, Peregrine, Burnelli monoplane, Stranraer.

P.240 (top): D.H. 88, Albatross, Fokker T.5, Amiot 353, Empire boat, Fiat G.12. **Bottom:** Henley, LeO 45, Master, Fokker T.9, Messenger, Ensign, Hurricane, T.H.K.2, Flamingo.

P.241 (top): Northrop-Bristol, A.S.45, F.K.57, Fokker D.21, Desford, Q.6. **Bottom:** Spitfire, M.18, D.520, Wirraway, Lancaster, Whirlwind, Beaufighter, Tempest, Mosquito.

P.242 (top): P.Z.L. Los, Me108, Battle, Renard 36M, Fulmar. **Bottom:** Stirling, Botha, Sunderland, Bolingbroke, Albemarle.

P.243 (top): Manchester, Defiant, Hereford, Lysander, Blenheim, Wellington. **Bottom:** Hampden, Anson, Widgeon, Skua, Lerwick.

IDENTITY PARADE (Cont.)

P.244 (top): Firebrand, Apollo, Viking, Solent, Halton, Theseus-Lincoln, Shetland, York, Typhoon. **Bottom:** Hythe, Warwick, Folland 43/37, Barracuda, Seaford, Oxford 4, Firefly, Wackett Trainer, Sandringham.

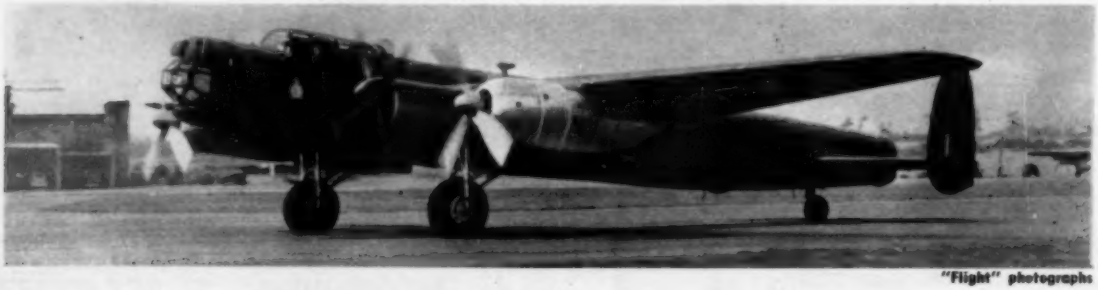
P.245 (top): Heston Racer, Bisley, Welkin, Proctor, Halifax, Blackburn B.20, Albacore, Hornet, Lincoln. **Bottom:** Gloster F.9/37, Drover, Beaufort, Manx, Merganser, Hillson bi-monoplane, Fokker G.1, Hastings, Balliol.

P.246 (top): Heron 1, S.E.2300, Fiat G.46, Ambrosini S.7, Alcotan, Me109 (Spain), Sealand, Aerovan, Heston A.2/45. **Bottom:** Marathon, Dove, Britannia, S.M.95, Heinkel He 111 (Spain), Ambassador, Sturgeon, M.S.570, Prince.

P.247 (top): Beverley, Pioneer, Hermes 4, Auster 7, Twin Pioneer, Eland-Convair, Proteus-Ambassador, Beaver, Freighter. **Bottom:** Hermes 5, S.O.30, Heron 2, Halcon, Princess, Tudor 2, Prentice, Athena, Universal.

P.248 (top): Provost, Hotspur, Herald, A.A.P.C. Trainer, Chipmunk, Heinkel 111 (C.A.S.A.), Viscount 748, Safir, Pembroke. **Bottom:** Languedoc, Azor, Vihuri, Auster A.2/45, Ju 52 (Sirio), Namcu, H.A.100D1, Ju 86 (Swedish), Shackleton.

Above: An early Lancaster 1 with de Havilland three-bladers. Below: the very first D.H. turbine airscrews flew on February 17th, 1947, fitted to the Bristol Theseus (outboard) on a Lincoln test-bed.



"Flight" photographs

ENTERPRISE IN AIRSCREWS . . .

was started for sale to industry at large. These were the inevitable bye-products of an active vibration department, whose experience in electronics was, early in 1952, to provide the nucleus of a team which began the design of guided weapons. It is no secret that, from small beginnings four years ago, the de Havilland missiles department has become an organization of considerable size. From what little is known from the outside, the new D.H. weapons are certain to be recognized as one of the greatest of all de Havilland technical achievements to date.

But the production of airscrews will remain the company's principal pre-occupation for as far ahead as can be seen. Separate interests there will always be: besides guided missiles, these already extend to the manufacture of aircraft cold-air units, turbine-driven electric alternators, radar scanners, electronic apparatus, plastic structures—even to an experimental 80ft windmill to derive electricity-producing power from the wind. But the airscrew is harnessed to the future of aviation as securely as is the name de Havilland.

J. M. R.

CONTRIBUTORS TO ACHIEVEMENT

The following is a list, provided by de Havilland Propellers, Ltd., of some of the firms who are suppliers of components and materials for the manufacture of their airscrews:

Accles and Pollock (*tubes for hollow steel blades*)
Bakelite (*synthetic resins*)
British Insulated Callender's Cables (*moulded cables and wire*)
The British Thomson-Houston Co. (*electric motors*)
British Tyre and Rubber Co. (*rubber de-icer mouldings*)
Chesterfield Tube Co. (*forgings for hollow steel blades*)
Coopers Mechanical Joints (*gaskets and shims*)
English Steel Forge and Engineering Corp. (*steel forgings*)
Samuel Fox (*steel sheet for hollow steel blades*)
M. H. Godden (Cheltenham) (*electric de-icing elements and heater mats*)
J. Holroyd (*phosphor bronze castings*)
Johnson, Matthey and Co. (*brazing foil for hollow steel blades*)
Richard Klinger (*gaskets*)
Marglass (*fibreglass cloth for spinners*)
Northern Aluminium (*Duralamin forgings*)
Plessey (*electric plugs and sockets*)
Ransome and Marles Bearing Co. (*bearings*)
Robert Riley (*springs*)
Joseph Sankey and Sons (*spinners*)
Sheffield Smelting Co. (*brazing foil for hollow steel blades*)
Sterling Metals (*magnesium castings*)
James Walker and Co. (*oil seals*)

A picture, taken recently specially for "Flight", which indicates the wide scope—including missile development— of de Havilland Propellers, Ltd., today. It shows the company's flight-test fleet at Hatfield:—from left to right: a Canberra B.2, much modified, with non-standard wing-fixtures; a Vampire N.F.10; the Hastings prototype with a water-spray-rig for airscrew de-icing tests; a Swift F.1, also with non-standard wing fixtures; a Mosquito; another Canberra B.2, with a flat nose surmounted by a probe; a black Meteor N.F.11; and a Firefly on which special wing-tip fixtures (presumably housing high-speed cameras) may be observed.

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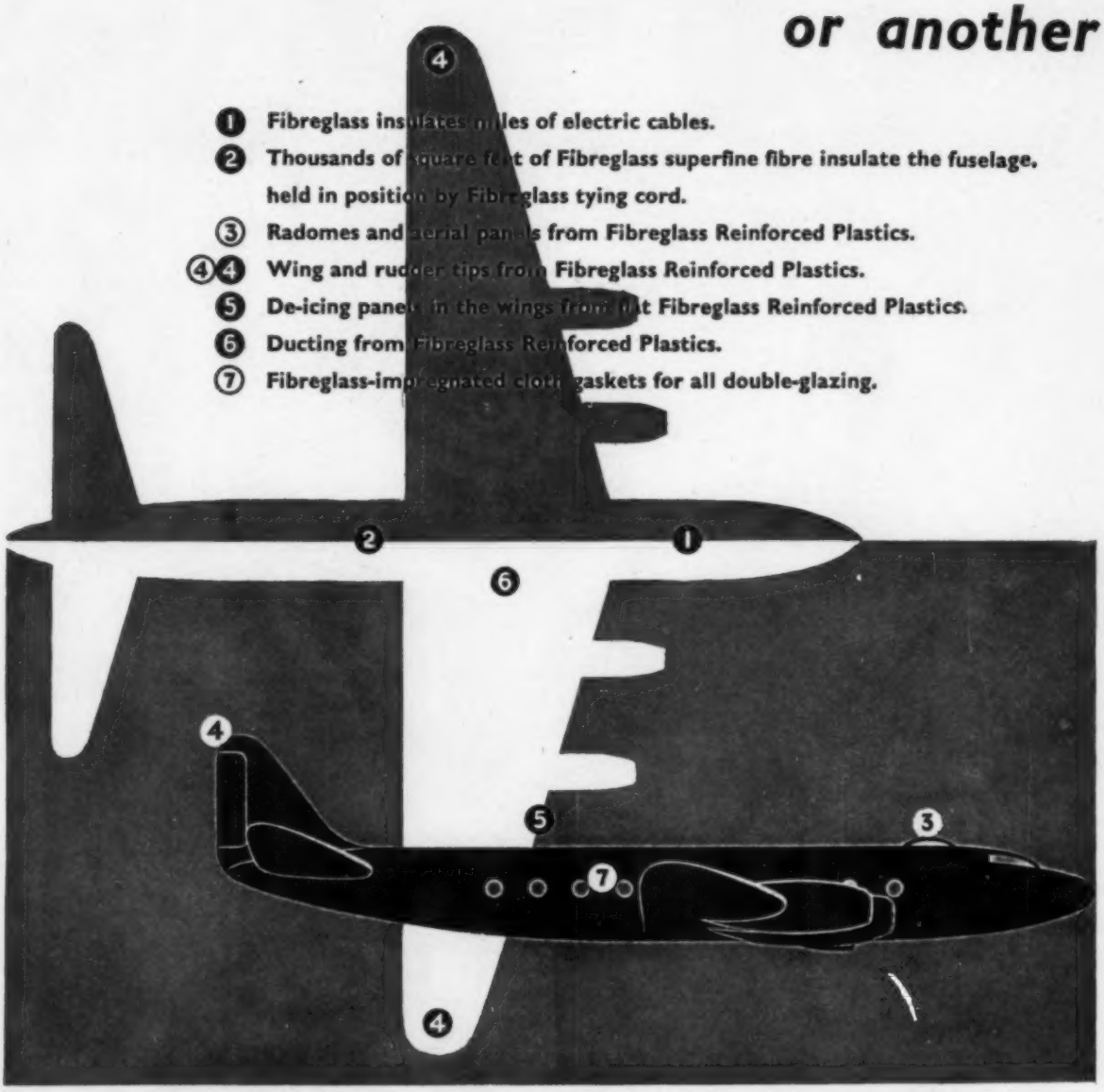

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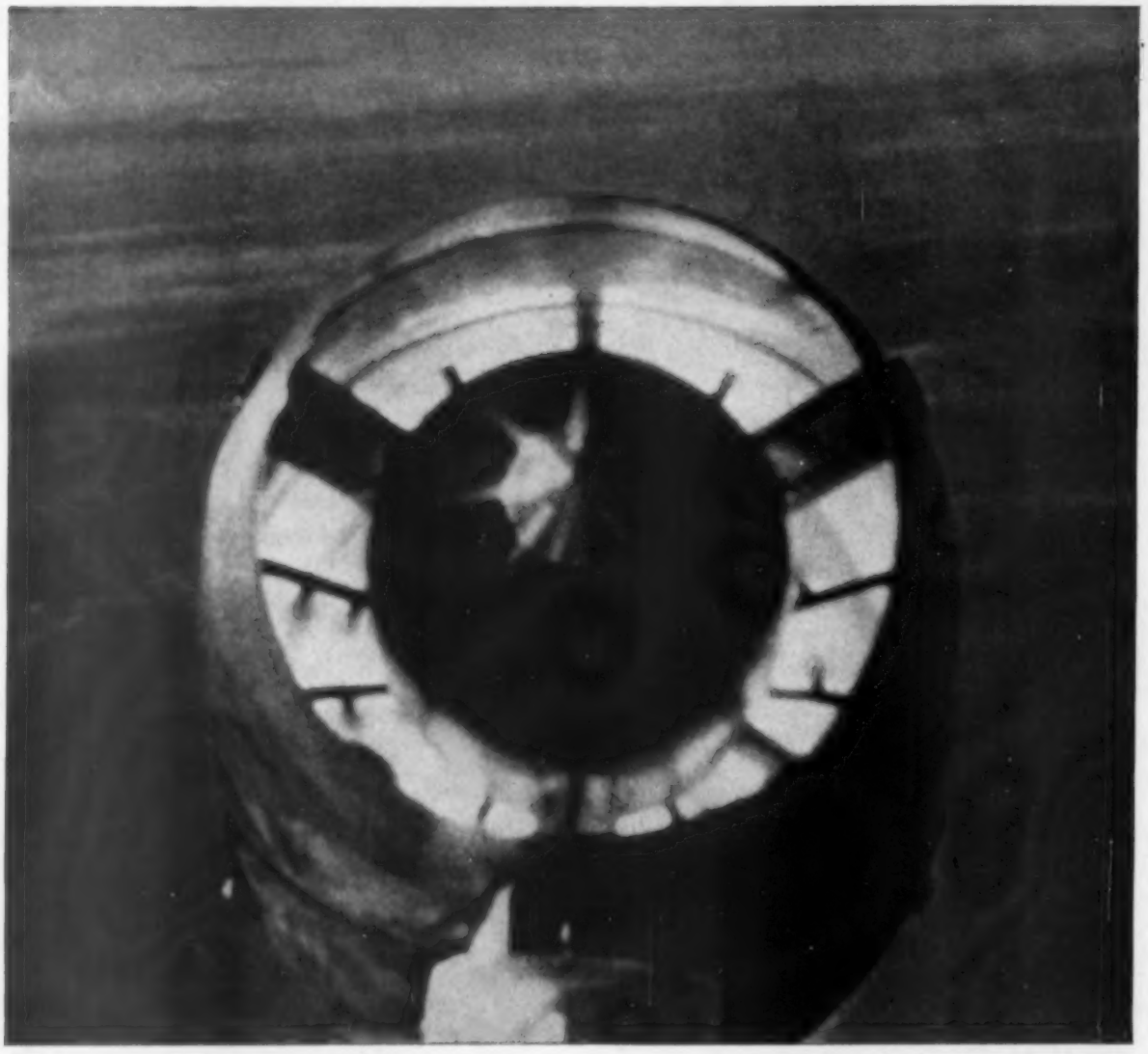

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HENSON AND STRINGFELLOW

Conclusion of the First Memorial Lecture before the R.Ae.S. at Yeovil

CONTINGENTS from the Bristol and Boscombe Down branches of the Royal Aeronautical Society attended the first Henson and Stringfellow Memorial Lecture, given before the Yeovil Branch of the Society on February 16th. The lecturers were the secretary and the former secretary of the Society, Dr. A. M. Ballantyne and Capt. J. Laurence Pritchard, and their paper was devoted to the work of W. S. Henson and John Stringfellow, who jointly carried out a series of experiments at Chard, Somerset (not far from Yeovil) between 1843 and 1847.

The visiting branches to the meeting were welcomed by Mr. E. C. Wheeldon, president of the host branch. Mr. D. L. Hollis-Williams, chairman of the branch, disclosed that members of the Stringfellow family were also among the visitors; and Mr. E. T. Jones, president-elect of the parent Society, introduced the lecturers.

After a summary of the paper had been read by Dr. Ballantyne, thanks were expressed to both authors by Dr. E. W. Still (alternate chairman, Yeovil branch) and Mr. Raoul Hafner (chairman of the Bristol branch). Following the meeting, a supper was held in Yeovil for members of the three branches.

We gave abstracts from the first part of the paper in our last week's issue; the final sections are summarized below.

Stringfellow and the 1868 Aeronautical Exhibition. — On October 14 1867 Brearey wrote to Stringfellow, "I enclose you a circular of our proposed Exhibition, as I hear you might perhaps have something to exhibit."

On November 21, 1867, Brearey, replying to a letter from Stringfellow, wrote, "I was very glad to receive your letter this morning. I quite agree with you that if you have succeeded in making a flying model you have solved a problem under discouraging circumstances. The next thing to do is to convince the world of it and no better opportunity exists for attracting general attention than the coming exhibition . . . . . "

On December 18, 1867 Brearey wrote, "I am very much obliged for your interesting letter and photos which I shall read and show at our Council meeting on Thursday. It is a great pity that experience like yours should be lost to the world, but I think that you see that the time has arrived when publicity may be given to your attempts. So far as I can see you would secure the prize to be given for the best working model, always supposing that it would maintain flight for the distance you state, 40 or 50 yards. I have yet to examine more closely with a magnifier, your photos. Does the machine carry its own motor?"

These photographs must have been of the 1848 model. From the letter it would appear that Brearey knew nothing about it and had not been down to Chard to see the model. The engine was missing, as already recorded. Stringfellow had evidently said he had referred to the experiments at Cremorne, and so the 40 yards. Yet the machine or a replica of it, with such an outstanding success behind it, was not entered for the Exhibition or discussed by the members of the Society during the three meetings held at the time of the Exhibition! Nor did Stringfellow say anything more than "It flew—in 1847." He gave no description of it, or where it flew, and put the date wrong by a year. Here, indeed, was the grand opportunity to "convince the world of it!"—an opportunity missed.

Unfortunately many of Stringfellow's replies to Brearey's letters are missing, but much may be learnt from Brearey's own letters. On November 25, 1867, Stringfellow wrote a letter from which it was clear that Stringfellow not only had no model ready, but he was thinking of making a multiplane, though a little doubtful as to the result.

Only a few weeks before the Aeronautical Exhibition was due to open, Stringfellow wrote, on June 4, 1868, to Brearey, "It would be desirable to know positively if the model could be exhibited in the interior. I should wish to know the length and height of the building clear of everything. I shall make it go from one end to the other BY SOME MEANS. . . . The machinery and things generally work very well, but I'm not certain the sustaining planes are the best possible arrangement."

Evidently Brearey was not clear what Springfellow meant in his letter, for on June 10th, the latter wrote again, "I am sorry if I have said anything to mislead you. In the letter you refer to I stated I would make it go from one end to the other of the building BY SOME MEANS. This can be done by a guide line and certainly in the first experiments I should not attempt to liberate it until it had thoroughly proved capable of self-control. Whatever shortcomings there may be at first, there is nothing in the principle but what may eventually be surmounted. . . . There is no room sufficiently large for experimenting in the neighborhood (i.e., Chard) or I should not have kept my old models rotting for years."

It still remains puzzling why he did not continue on the lines which had apparently been so successful. As it was, he abandoned certain features of his 1848 model as a flexible trailing edge and monoplane construction, in the construction of the triplane. No detailed description of the triplane was published at the time. The Science Museum gives the wing area as 28 sq ft and total weight as 12 lb. Chanute adds 8 sq ft for the tail, making 36 sq ft in all, giving a wing loading $\frac{1}{3}$ lb to the sq ft, "which was certainly ample support. The engine is said to have developed a third of a horsepower, but its weight was not stated. Like the earlier model of 1848, the triplane was suspended from an apparatus running along a wire on grooved wheels, but with no release mechanism as the Crystal Palace authorities forbade free flights.

Brearey had asked Stringfellow, in his letter of December 18, 1867 to send him a paper for the next general meeting in February. But Stringfellow always proved shy of giving a detail account of what he was doing.

"I am afraid I could not send you a paper worth reading," he wrote on April 1st, 1868. "I had commenced a paper intending to give you some little of my former experiments but am so bad with rheumatics in my head that I am obliged to give it up. . . . I am getting on very slowly with the model, but I think tolerable satisfactorily and I hope I shall have it finished in time. . . .

Stringfellow left no record why he was making the "considerable deviation" from his former model, but the conclusion may be drawn that he was only doing what Cayley and Wenham had suggested, building a triplane, but without fully knowing what the effect would be.

The model was undoubtedly a great attraction and beautifully made. That was Stringfellow's metier.

At the following meeting of the Society, on July 3 1868, the chairman praised the triplane and expressed the hope that Stringfellow would demonstrate it in free flight. But no such attempt was publicly made. Following Stringfellow's death in 1883, and not till then, Brearey revealed that the triplane had been tested off the wire.

"In the basement afterwards," (i.e., of the Crystal Palace), wrote Brearey, "the author assisted to hold a canvas with which to break the fall of the model when liberated. When freed, it descended an incline with apparent lightness, until it caught in the canvas; but the impression conveyed to us was that had there been sufficient fall, it would have recovered itself."

There was no form of control whatever in the triplane, so that its chance of recovery was pretty small.

"It was intended at the last to set the model free in the open country," continued Brearey, "But it was found that the engine, which had done much work, required repairs. Many months afterwards, in the presence of the author, an experiment was tried in a field at Chard, by means of a wire stretched across it. The engine was fed with methylated spirits, and during some portion of its run under the wire the draught occasioned thereby invariably extinguished the flames and so these interesting trials were rendered abortive."

Abel Hureau de Villeneuve, editor of *L'Aeronaute*, wrote in May, 1970, concerning the appearance of the triplane at the 1868 Exhibition: "Mr. Stringfellow's machine, hung from pulleys running on a horizontal iron wire, was drawn forward by the action of its screws. If the planes had lifted at all, the cords which held the machine to the pulleys would have been slackened by the lifting action. But we all saw that these cords remained taut all the time and showed no slackening. Therefore, despite all Mr. Stringfellow's assertions, it is safe to say that a machine like the one exhibited in London is quite incapable of rising."

The Juror's report gave a long description of Stringfellow's prize-winning engines, beginning with the words "Mr. Stringfellow's boiler and engine, from the cleverness displayed in its construction and design, merits a particular description. The steam engine does not differ from an ordinary one except in the precautions to ensure lightness."

There is no suggestion in the Report that there was anything original or novel about the engine. The whole praise was given to its workmanship and the fact it was constructed in the lightest way.

Stringfellow's reputation can rest firmly on his work on light

HENSON AND STRINGFELLOW . . .

steam engines, on his craftsmanship of unusual excellence.

But only, in a very much lesser degree, despite the time and energy he spent at one stage with Henson and for a brief while after, and the results which were claimed for his work, can it be said to have deserved the reputation given to him by historians.

"As the figure of Henson emerges from its shadowy background," said Paul Johnston, "it is becoming more and more apparent that he should be given equal credit with his collaborator for the first step in the final development of heavier than air flight, even though he was not present to witness the final triumph."

The Final Years.—The Aeronautical Exhibition at the Crystal Palace in July 1868 saw the highlights of Stringfellow's experiments.

With the prize money for his engine Stringfellow built a room in Chard about 70 feet in length, with the intention of carrying out further experiments.

Well over a score of letters from Brearey from 1869 to 1881 have been preserved and not only reveal some of Stringfellow's character, but the fact that he was not well-to-do and often unable to respond to the demands made to him to make an engine specially for an aeronautical experiment.

From the time of the close of the Exhibition until his death some fifteen years later, there is nothing on record to indicate any further achievement or advance, in his ideas.

Even in Stringfellow's '81st year Brearey was hopefully trying what he had failed to succeed in doing over the years the two had known each other, to get him to build a light engine to order.

Yet in the Memoir of his old friend, Brearey made no comment of his own on the experiments at Chard or Cremorne, as to their value or otherwise. He merely repeats, word for word, the account he published in 1869. Of the 1868 triplane model he quotes what the press saw of its flights along the wire in the Crystal Palace, but does not say whether he agrees or not with their statements. His own report is that he saw it tried off the wire in the basement of the Palace and in a field at Chard, with unsuccessful results. He also, as Chanute had done, questioned its stability.

Relating what happened after the Exhibition Brearey noted that failing eyesight prevented Stringfellow from doing any fine work.

"Three months before his death he felt that the work he was executing for its improvement was a mistake, and to his son he said 'I've hung it up, Fred. I shall touch it no more.'

"Had his cunning not departed from him, many a light engine would have turned out in satisfaction of the enquiries and demands of aeronautical inventors."

Of his aeronautical endeavours as such, patient, arduous, and meticulous as they were in many ways, all that Brearey could say was:

"All we are justified in concluding is that John Stringfellow considered that aerial navigation was capable of accomplishment and that he gave much time and means to its elucidation."

Not a single word of praise, nor even a suggestion in that conclusion, of any successful flying model experiments, from the one man who was in the position to give that praise.

The work of Henson and Stringfellow cannot be separated, any more than that of Orville and Wilbur Wright.

This assessment does not deny an important place in the history of aviation to John Stringfellow, but it does attempt to show that William Samuel Henson holds a place at least as important if not greater, and to add that if John Stringfellow had not met and worked with Henson, his name would not be known in aeronautical history.

NEW BRISTOL POST

IN order to facilitate the co-ordination of supplies of raw materials, component parts and sub-contracted work for the major projects which they have in hand, Bristol Aircraft, Ltd., have established the new post of supplies manager. It is to be filled by Mr. J. J. Pritchard, who has had much experience as chief buyer of the former aircraft division, and who will control the work of the sub-contracts and purchasing departments. Mr. C. V. Redford, as sub-contracts manager, will be responsible to Mr. Pritchard, as will also the new chief buyer, whose appointment will be announced shortly. Mr. Pritchard, who is 40, joined the company's production department in 1937, becoming assistant spares manager in 1940, and spares manager in 1943. In 1945 he was appointed material controller, and when the material control and purchasing departments were re-organized in 1948 he became deputy chief buyer. He succeeded to the post of chief buyer in 1952.

Mr. Pritchard.

R.A.E. PRIZEGIVING

FOR the fifth year in succession (1955), all the medals and prizes for aeronautical engineering awarded by the City and Guilds Institute and the Livery companies were won by students of the Royal Aeronautical Establishment Technical College. This news was given by Mr. R. D. Peggs, M.A., Principal of the College, at the annual prize distribution at Farnborough on February 10th. During the 1954-55 session, he reported, students had obtained eight B.Sc. (Eng.) degrees, nine exemptions from A.F.R.Ae.S. examinations, 38 Higher National Certificates in mechanical engineering, 17 H.N.Cs in electrical engineering and five H.N.Cs in production engineering, in addition to numerous other awards.

New courses which had been introduced, Mr. Peggs stated, included a five-year course for design engineers, one in electronic principles and practice for craftsmen, post-graduate courses in servomechanisms and in advanced electronics, and a new full-time course for assistant experimental officers.

After congratulating the staff and students on their work, Mr. G. W. H. Gardner, C.B., C.B.E., B.Sc., Director of the R.A.E. and chairman of the prize-giving ceremony, introduced Sir Richard Southwell, M.A., LL.D., F.R.S., who presented the certificates, awards and prizes. An address by Sir William S. Farren, chairman of the College Advisory Board, was followed by a report of students' activities and a vote of thanks to Sir Richard Southwell by the president of the Students' Union, Mr. Scott Gittoes.

The awards included:—Grinsted Prize for the best student of the year, D. R. Rees; Perring Prize for student apprentices, J. Cox; Farren Prize for craft apprentices, M. H. Wadmore; Director's Prize for D.O. apprentices, D. R. B. Young; Hilda-Lyon Prize for scientific assistants, J. Greenland; Principal's Prize for outstanding leadership, D. J. Faddy; and the Royal Aeronautical Society's E. J. N. Archbold Memorial Prize, W. J. D. Brooks and E. J. John (1954), J. T. Greenslade (1955).

JOHN BULL JUBILEE

TO celebrate the 50th anniversary of the foundation of John Bull Rubber Co., Ltd., a dinner held in Leicester on February 17th was attended by more than 1,800 employees of the firm and its associated companies, Metalastik, Ltd., Precision Rubbers, Ltd., and C.P. Engineering Co., Ltd.; also present were many guests, both from home and overseas.

Speeches were by the company's chairman, Mr. John Cecil Burton, who, with his brother, Mr. Hubert Henry Burton, founded the company in February 1906; the Deputy Lord Mayor of Leicester, Alderman C. Harris; Mr. Frank Aubrey Pope, who is a director of John Bull; Sir Gilmour Jenkins, Permanent Secretary to the Ministry of Transport and Civil Aviation; and Mr. Jonas Oglaend, a Danish customer of the firm.

TOKEN OF APPRECIATION

Members of Saunders-Roe aircraft design team, all with 20 years or more of service with the company, subscribed to a gift of 13 long-playing records and an illuminated address for their retiring technical director, Mr. H. Knowler (left). The presentation was made by Mr. J. R. Farrow (right) at East Cowes. In the background is Mr. A. W. Prickett, one of the longest-serving designers at Saunders-Roe, Ltd.

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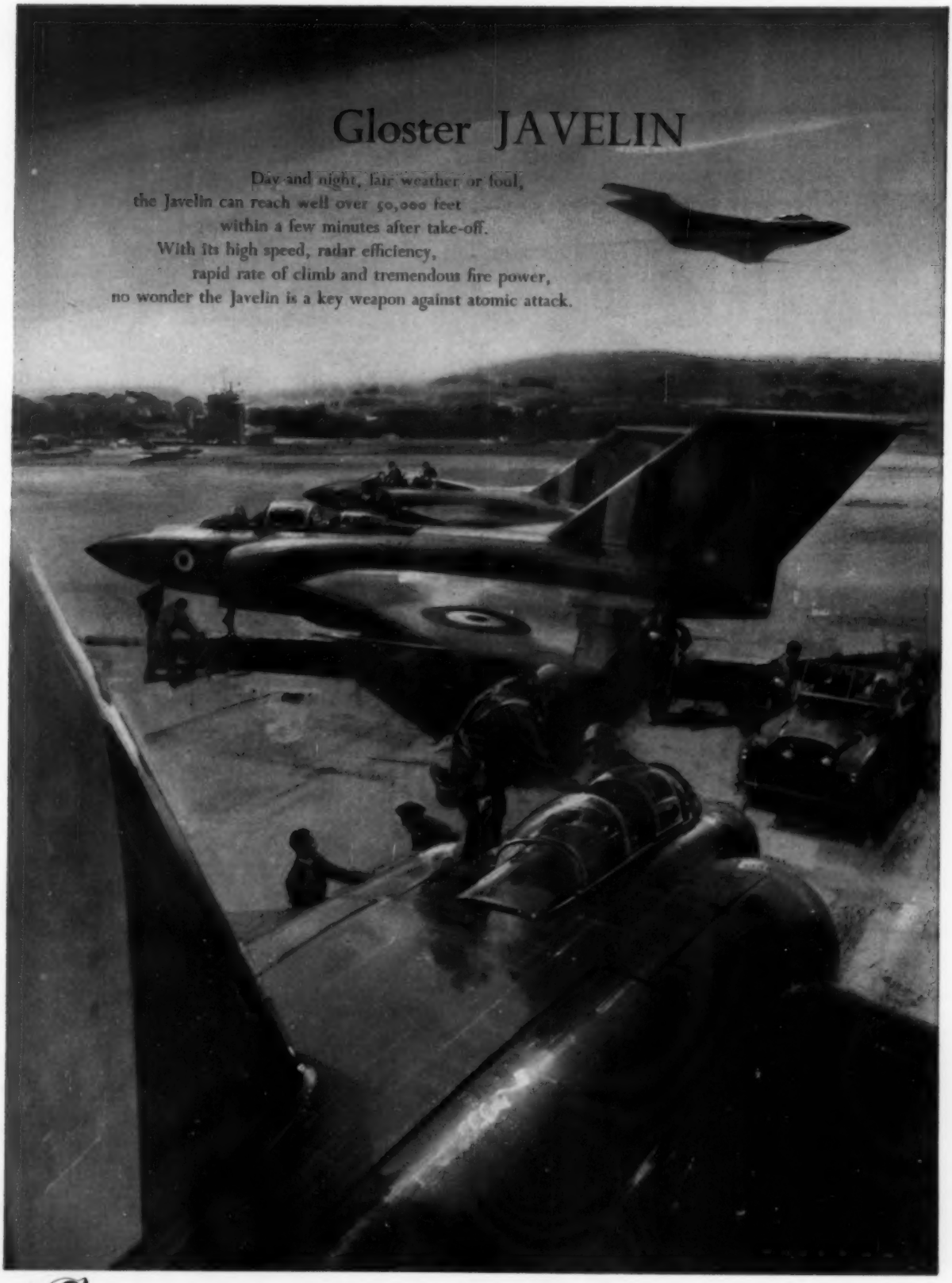

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CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

High-utilization Constellations

IN the article *A Constellation Saga*, in *Flight* of January 27th, the author remarks that it would be interesting to know the number of flying hours completed by F-BAZR since it went into service with Air France.

The L.749 Constellation F-BAZR had completed 1,325 hr when it was taken over by Air France on January 15th, 1949. On February 1st, 1956, the total number of hours had risen to 20,377, that is to say it had flown 19,052 hr on behalf of Air France, which represents an annual utilization of 2,700 hr and a daily average of 7 hr 24 min.

It might be interesting to conclude this information regarding F-BAZR by giving a few details of the utilization of our fleet of L.749 Constellations which, on February 1st, 1956, still comprised 17 machines. Since June, 1947, the date our first machine of this type entered service, the total number of flying hours completed amount to 405,900.

The remaining 17 aircraft have achieved a total of 343,432 hr since manufacture, which represents an average of 20,200 hr.

Of these 17 machines, nine have flown a greater number of hours than F-BAZR. Among these figures F-BAZJ (No. 2514) which was the first to be accepted (June 26th, 1947) and which had completed 22,101 hr up to February 1st, 1956, giving an average daily utilization of 7 hr 2 min.

The aircraft with the greatest number of hours in the air is F-BAZU (No. 2525) with 23,377 hr. It was delivered to Air France on June 28, 1950, after having flown 5,573 hr, for P.A.A. The 17,804 hr it has flown with Air France represent an average utilization of 8 hr 43 min per day and 3,170 hr per year.

Two other aircraft, also bought from P.A.A. in 1950, have also flown more than 3,000 hr per year. They are:—

F-BAZV (No. 2526) which has completed 17,605 hr with Air France since June 5th, 1950 (hours flown before then: 4,217) representing a daily average of 8 hr 31 min.

F-BAZX (No. 2527) whose flying hours for Air France since August 12th, 1950, total 17,306 (5,428 hr with P.A.A.) giving an average utilization of 8 hr 40 min daily.

Paris 8e. F. DE LA BROSSE,
Département des Relations Extérieures, Air France.

Simian Stratospherics

YOU caused tears of pain on the pages [February 10th] devoted to animals and other humans in various pathetic situations. At the bottom of p. 163 you say that the "monkey does not appear to be unduly perturbed by his unusual equipment." Since about the only part of the creature that can be seen is its ear, I find it difficult to agree with the comment. With colour printing you might have found that the ear was red—but otherwise there's nothing to prove that the monkey isn't screaming its little head off and being held down, for the portrait photographer, by a football team of earnest Pavlovs.

London, S.W.3. G. BROWNE.

No. 18 Squadron Recollections

I WAS extremely interested in your history of 18 Squadron, having been a member of that squadron from November 1939 until September 1940.

The author has, presumably, had access to the official records for May 1940, but I imagine these were completed subsequently from memory and may well be slightly inaccurate. For instance, the first two pilots of the squadron to reach Lympne on May 19th were myself and Sgt. Holland; when the orders to move to the U.K. were received about 4 p.m. on the 19th, most of the officers were in Abbeville in search of a bath, having been "stood down" for 24 hours. In consequence they were not able to fly to England until the morning of the 20th, arriving at Lympne about 7.30 a.m. We all moved from there to Watton during the afternoon of the 20th, the remaining pilots at that time being S/L. Rogers, F/L. Langebear, F/O. Rees, P/O. Dickens, P/O. Light, Sgt. Holland and myself.

I think I should also correct the statement that the Blenheims landed "by mistake" at Abbeville. At 8 p.m. on May 18th, the officers of the squadron were sitting down to their first proper meal for 48 hours, provided by the servants of the chateau in which we were temporarily billetted. At 8.30 p.m. orders came through for us to move to Crécy. Sunset was at 8.50 p.m., Crécy was not marked on any maps, and we had only the vaguest instructions as to its location. Not unnaturally, we failed to find it, and had it not been for the good sense of some officers at Abbeville who lit two makeshift flares, all aircraft would probably have been lost. Incidentally, when we did move to Crécy "aerodrome" next day, it proved to be two fields, separated by a sunken road across which one had to "jump" one's aircraft, and with an invisible (and unmarked) wire fence along its down-wind boundary. One aircraft, flown by Dicky Wheldon, landed without flaps, carried away its undercarriage and finished up on its belly, with 1,000 lb of bombs on board.

Cambridge. A. HUGHES, W/CDR.,
Commanding Cambridge University Air Squadron.

In Memory of Alan Marsh

THE name of Alan Marsh will be familiar to many of your readers, both as a professional pilot of the highest skill and integrity, and as an instructor of forceful persuasion and infinite patience. When he died in 1951 whilst flying an experimental helicopter, a life dedicated to aviation, and particularly to that of rotary wings, came to an untimely end. But his memory lives on, and those who worked and played with him intend that it shall be perpetuated in a worthy manner.

That is the reason for the existence of the Alan Marsh Memorial Trust Fund, the main object of which is to provide each year, from income, sufficient financial support to enable a young engineer with a technical background in the rotary-wing field to acquire first hand experience, at a recognized training establishment, of the problems associated with helicopter pilotage.

But the cost of such flying is high; and whilst, with but little effort on our part, donations to the Fund already amount to £1,300, this capital sum needs to be at least doubled to produce the necessary minimum annual income.

A medal is also to be awarded each year for outstanding pilotage achievement, and the cost of producing these medals is high.

May I, therefore, on behalf of this good cause, ask that your journal will make our objective known to that wider circle of Alan's friends now scattered far and wide, and with whom contact by any other means is impracticable. Concurrently, an appeal is being circulated to all members of the Helicopter Association, of which Alan Marsh was first chairman, and which can be fairly said to have been the child of his imagination and initiative.

Will those who feel our objective worthy of their practical support, please send their contributions to the Honorary Secretary, the Helicopter Association of Great Britain, 4 The Sanctuary, Westminster, London, S.W.1?

London, S.W.1. R. A. C. BRIE,
Chairman of the Trustees; Vice-President, Helicopter Association.

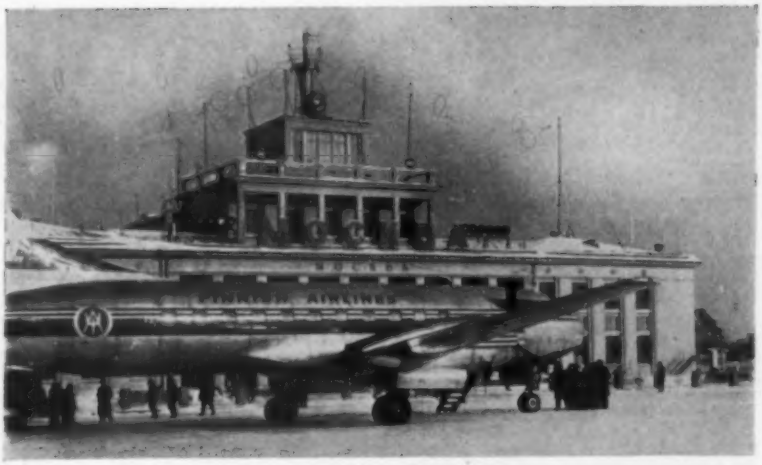
FORTHCOMING EVENTS

Mar. 6. R.Ae.S.: Graduates and Students Section: Annual General Meeting and Film Show.
Mar. 7. R.Ae.S.: Ninth Louis Bleriot Lecture, in Paris: "Organization of Aeronautical Research", by E. T. Jones, C.B., O.B.E., M.Eng. F.R.Ae.S.
Mar. 7. British Interplanetary Society: "Combustion Chambers for Rocket Engines", by Prof. A. D. Baxter, M.Eng., M.I.Mech.E., F.R.Ae.S., F.Inst.P.
Mar. 7. Kronfeld Club: "Ultra Light Aircraft, Ancient and Modern", by H. Best Devereux.
Mar. 7. London Society of Air-Britain: Film Show.
Mar. 9. Helicopter Association: Lecture.
Mar. 14. Kronfeld Club: "The Kites, Gliders and Aeroplanes of Col. S. F. Cody", with slides by G. A. Broomfield.
Mar. 15. R.Ae.S.: Main Lecture: "The High Temperature Turbojet Engine", by D. G. Ainley, A.F.R.Ae.S.
Mar. 16. British Gliding Association: Annual Ball.
Mar. 17. British Gliding Association: Annual General Meeting.
Mar. 20. R.Ae.S.: Section Lecture: "Experiments on Flow Over Swept Back Wings," by P. T. Fink, B.E., A.F.R.Ae.S.
Mar. 21. R.Ae.S.: First Chadwick Memorial Lecture: "The Life and Work of Roy Chadwick," by H. Rogerson, M.B.E., F.R.Ae.S. (Main lecture, in Manchester.)
Mar. 21. Kronfeld Club: Film Show.

R.Ae.S. Branch Fixtures (to March 8th)

Mar. 6, *Belfast*, "Aircraft and Shipyard Lofting", by A.C. Patrick; *Boscombe Down*, Film or Discussion; *Bristol*, Third Barnwell Memorial Lecture: "Achievements and Prospects in the Field of Aircraft Engines", by A.C. Lovesey. Mar. 8, *Isle of Wight*, "Fatigue of Metals", by Maj. P.L. Teed.

A Convair 340 of Finnish Air Lines landed on the snow-covered airport of Moscow for the first time on February 10th, after a proving flight for the six-times-weekly service—the first to be operated by a non-Communist country—which began on February 18th between Copenhagen, Helsinki and Moscow.



CIVIL AVIATION

DEBUT OF THE VISCOUNT 700D—

AS recorded by the photograph below, the first Viscount 700D has been completed at the Vickers factory at Hurn. Allocated to Capital Airlines it had, as this issue went to press, completed its flight trials and was due for delivery—with a sister aircraft—to the U.S.A. where it will join the nine Capital Viscounts already in service. The aircraft is the North American "plush" version of the 700D, known as the 771D—in effect the basic North American 770D with extras.

Completion of the first Viscount 700D makes it appropriate to recall the improvements offered by this new version and its 770D and 771D North American cousins. The basic 700D embodies the experience Vickers have to date of the requirements of 28 different customers, plus the day to day operation of the earlier Viscount 700, amounting now to about 150,000 hr. The most important improvements include the four-tank fuel system (with the option of long-range wing slipper tanks); an improved cockpit, suitable for two crew operation; a comprehensive installation of British radio equipment; and luxurious American-style cabin appointments with improved panelling and upholstery and two toilets. Maximum take-off weight of the 700D is increased from 58,000 lb to 60,000 lb, or 62,000 lb with slipper tanks. A total of 800 extra horsepower is provided by the four Dart RDa.6 Mk 510 engines, each of 1,600 s.h.p. compared with the Dart 506s of the series 700. The increased power raises cruising speed from 320 to 325 m.p.h. at a lower fuel consumption—305 gal per hour compared with 309 for the Dart 506. Rotol airscrews (or, alternatively, de Havilland units) have blades of increased chord and high-activity section, and a lower diameter resulting in slightly lower tip-speeds. Maximum landing weight is increased from 52,000 lb to 54,000 lb, allowing full payload to be carried with full fuel reserves. Seating accommodation is for 40 to 58 passengers.

The 770D, the North American "basic" version, is in all respects a 700D embodying North American equipment and modifications to meet the requirements of the C.A.A. One typical such requirement is the raising of landing weight by 3,500 lb to 57,500 lb to cater for the extra fuel reserves needed for high-density American domestic operations. The 771D is, in turn, a refinement of the 770D with all the optional extras so far chosen by the principal North American operators. These include built-in air-stairs, with front-door passenger loading, racks for carry-on luggage, airscrew reversing, and the Janitrol cabin heater. As in the 770D, seating accommodation is for 40 to 48 passengers.

—AND T.C.A.'s THIRD REPEAT ORDER

AS this issue goes to press we learn that Trans-Canada Air Lines have ordered a further 11 Viscount 700 aircraft (Dart RDa.3 Mk 506 engines). This is T.C.A.'s third repeat order, bringing their total order to 36 aircraft: the first order for 15 aircraft was in 1952, which was raised to 22 in August, 1954 and to 25 in April, 1955. The original order for 15 was completed recently, and a total of 25 aircraft will have been delivered by about this time next year. Delivery of the further 11 just announced will begin soon after that.

T.C.A.'s Viscount services now extend to 11 Canadian cities and to New York and Chicago in the U.S.A. Their latest order brings the number of Viscounts sold to 288. Total value, with spares, approaches £100 million.

AIRPORTS FOR THE DC-8 AND 707

ADDRESSING the Jet Age Conference of the Air Force Association in Washington recently Mr. Charles J. Lowen, Administrator of Civil Aeronautics said: "While our major airports will be able to handle domestic jet operations they may come into trouble when it comes to jet intercontinental flights." He said that C.A.B. were "urgently reviewing" the situation, under

First picture of the new Viscount 700D shows the slightly different profile of the more powerful (1,600 s.h.p.) Dart 510 nacelles. This aircraft is allocated to Capital, and is the U.S. airline's tenth Viscount. The 700D has increased take-off weight, and a higher landing weight which permits operation with full payload and fuel reserves. Cruising speed is up to 325 m.p.h. and consumption down by 1.3 per cent.

(5) MERITS OF THE GNAT

Maintenance

The ease with which the Gnat can be maintained has been described as "a remarkable contrast to current types". The contrast results from the thought given to maintenance in the design stage and from the many advantages which small size and light weight confer. Among many other maintenance features the Gnat has

(a) A working height that makes servicing platforms unnecessary.

(b) A one-piece wing which, secured to the fuselage at only four main points and carrying no fuel tanks, armament, controls or landing gear, can be fitted and removed with little trouble.

(c) A single inspection panel that gives direct access to all engine accessories.

(d) A quickly-removable rear fuselage and a short cantilevered jet-pipe, which facilitate engine change.

FLIGHT EXPERIENCE WITH PROTOTYPES HAS SHOWN THAT THE SERVICING MAN-HOURS OF THE GNAT PER FLYING HOUR ARE UNUSUALLY LOW

WHERE THE GNAT ALSO SCORES

Judged by conventional fighter standards, the Gnat :

(1) has a higher service ceiling, higher rate of climb and better manœuvrability.

(2) combines hard-hitting armament with exceptional stability at all speeds.

(3) can be transported more easily, and is less exacting in its airfield requirements.

(4) is easier to produce.

(5) costs far less to buy and operate.

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CIVIL AVIATION . . .

which Federal aid is granted for the development of international airports with runway lengths up to 8,400ft.(with the local government paying about half the cost). On the subject of runway bearing-strength Mr. Lowen pointed out that it meant nothing to say that a jet transport weighs, say, 280,000 lb: what did matter was how that load was distributed. Idlewild, for example, would support a hypothetical single-wheel aircraft of 200,000 lb but would take a dual tandem-wheel aircraft weighing 500,000 lb. On this basis many of the large U.S. airports already had adequate bearing strength, and where beefing up was needed it would be possible to install an overlay, which would be less costly than laying a new runway. On the topic of traffic control Mr. Lowen said that the primary purpose of new navaid facilities—for which $40m was called for in the President's budget message—would be to extend control above 24,000ft. "We would", he said, "move our traffic control into the jet age immediately. The military . . . want such service, and we propose to give it to them, and by so doing to perfect our methods for the day when civil jets will add their numbers to the upper strata traffic."

BREVITIES

TALKS in Dublin on the revision of the 1946 Anglo-Irish air agreement began on February 20th. Discussions are aimed at the drafting of a new agreement between B.E.A. and Aer Lingus about the sharing of traffic, and, it is understood, the extent to which Aer Rianta will participate.

The "threatened traffic jams on the world airways" will, say I.A.T.A., be a prominent item on the agenda of the ninth annual technical conference at San Remo, Italy, from May 7th to 19th.

* * *

DC-6B, F-BGOD, of the French airline T.A.I. crashed 15 miles south east of Cairo on February 20th en route from Saigon. Of the 64 people on board 52 died; six of the crew, including the captain, survived.

* * *

York G-ANSY of Scottish Airlines, carrying 45 Service personnel and a crew of five from Egypt to the United Kingdom, crashed after taking off from Luqa, Malta, on February 18th. The passengers and crew were killed.

* * *

PanAm are to employ as stewardesses 50 British subjects between the ages of 21 and 27 for the airline's North Atlantic and Middle East schedules. The girls will be based in New York City, flying up to 85 hours per month. Starting salary is £82 per month.

* * *

Final arrangements have been made for Pacific Western Airlines of Vancouver to acquire Associated Airways of Edmonton. Last year the airline took over Queen Charlotte Airlines.

* * *

Mr. Geoffrey Gibbons, has been made the assistant traffic manager of British European Airways.

* * *

The C.A.B. has now approved a temporary ten per cent increase in first-class transatlantic and trans-Pacific fares. This is a reversal of the board's refusal on February 2nd to approve increases agreed by I.A.T.A.

CLUB AND GLIDING NEWS

SINCE the inception of the A.T.C. flying scholarship scheme in 1950, over 1,500 cadets have received flying instruction up to P.P.L. standard. This was disclosed by Air Chief Marshal Sir Ronald Ivelaw-Chapman, speaking at the annual dinner of the Association of British Aero Clubs and Centres at the Waldorf Hotel, London, on Friday, February 17th. Of those cadets, he said, over 600 had entered regular R.A.F. service, more than 230 had served as National Service pilots and 120 were members of the Auxiliary and Reserve branches.

At the dinner the health of the Association was proposed by Mr. J. A. Boyd-Carpenter, M.P., Minister of Pensions and National Insurance and previously Minister of Transport and Civil Aviation. Replying, Mr. Geoffrey de Freitas, M.P., a vice-president of the Association, repeated the criticism made in the A.B.A.C. report (reported in *Flight* of February 17th) concerning the arrangement whereby club landing-cards for use at certain State aerodromes are issued by the Royal Aero Club and not by the Association. An immediate objection to this reference was voiced by Mr. S. Kenneth Davies, chairman of the Royal Aero Club, who was present as a guest and who later left the dinner, apparently in protest, during Mr. de Freitas' speech.

The toast of the guests was proposed by W/C. R. J. B. Pearse, vice-chairman of the Association, and the reply was made by Air Chief Marshal Sir Ronald Ivelaw-Chapman, Vice-Chief of the Air Staff. Sir Ronald referred to the recent change in emphasis in the flying-scholarship scheme; the Service's requirement, he said, was no longer for a large reserve of pilots; a high rate of recruiting must now be maintained, together with a higher standard of selection. The annual target number of scholarships was 400; 350 had been awarded in 1954 out of more than 600 applications, and 197 out of 450 applications in 1955.

The Lennox-Boyd Efficiency Trophy for 1954 was next presented by Mr. A. T. Lennox-Boyd, Secretary of State for the Colonies and donor of the trophy, to Air Chief Marshal Sir William Elliot, who received it on behalf of the West London Aero Club. The final speaker at the dinner was Monsieur l'Abbé Amiard of the French Fédération Nationale Aeronautique, who reported that his own home-built Jodel had made its first flight at Flers, and went on to urge all present to attend his club's rally there over the weekend of June 30th—July 1st.

A NEW hill site near Cocking, on the South Downs, was used for the first time by members of the Lasham Gliding Centre on Sunday, February 19th, when a Tiger Moth tug and five sailplanes were flown there by a party under C.F.I. Derek Piggott. The site, which has been loaned by Lord Cowdray, consists of a field large enough for aero-towing and situated at the top of the hill.

During the first visit, Lt. Virginia Sweet, U.S.A.F., Bruce Sinclair and Ernie Smith completed their "Silver C" five-hour duration legs, and reported experiencing thermals to 2,400ft and lift of 20ft/sec. It is hoped that a large number of five-hour flights will be completed from Cocking this year.

Other news from Lasham is that the Surrey Gliding Club have now bought the prototype Slingsby T.42 Eagle (which will be used for advanced training); and that over 800 gliding-course enquiries were received following the recent B.B.C. "Holiday Hour" programme featuring a visit to the aerodrome.

AN appeal for funds for the Cambridge University Gliding Club is being made in an endeavour to prevent the club from ceasing operations. The financial difficulties were outlined by Dr. J.W.S. Pringle, F.R.S., president of the club, at the annual dinner in Cambridge on Saturday, February 18th. Other speakers at the dinner, which was attended by 64 members and guests, were A. Alexander, John Furlong and Hugo Trotter. The appeal is for £4,000. The chairman of the appeal committee, Dr. Alice Roughton, said that £500 was required immediately if the club, whose membership is at present 120, was not to close by the end of the academic year.

CELEBRATION of the Midland Gliding Club's twenty-first birthday took place at a dinner in the Long Mynd clubhouse recently, at which Mr. Robert Neill, chairman, recalled the club's pre-war history. During 1955, it was reported, 5,470 launches were made and 2,271 flying hours were logged.

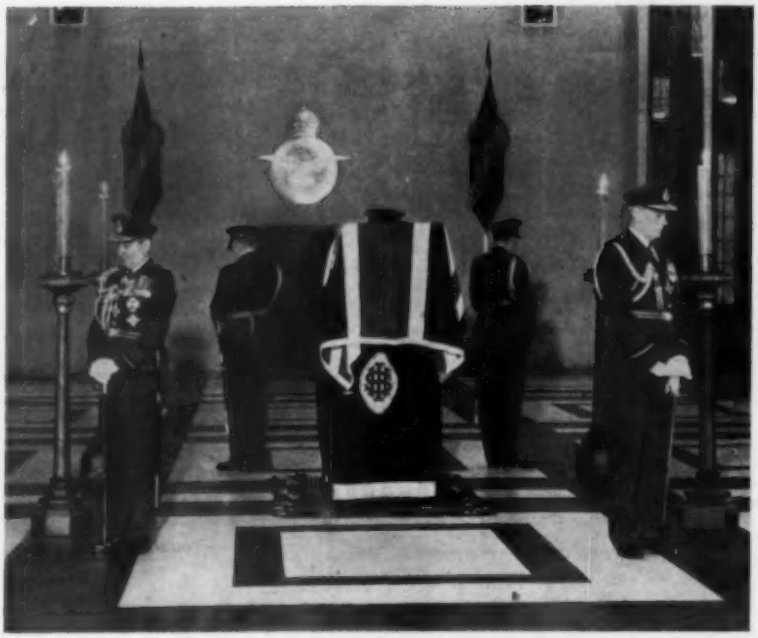
THE remission of import duty on light aircraft suitable for training purposes has been announced by the New Zealand Minister of Customs, Mr. D. J. Eyre. This decision, he said, was intended to give further help to aero clubs in the important work of training pilots.

RECENTLY reported by Warsaw Radio is the setting up of an experimental gliding establishment in Bielsko, Poland, for the construction of new sailplanes and for gliding research in preparation for Poland's participation in the 1956 World Gliding Championships at St. Yan. Three new versions of the Jaskolka single-seater are planned, in addition to the Nietoperz (a tailless design); an all-metal machine; and one incorporating the extensive use of plastics. Experiments with jettisonable rockets for the launching of gliders, it is reported, are also being made.

SEVEN competitors for the 1956 flying scholarships awarded by the Women's Junior Air Corps received trial flying lessons at Fair Oaks recently. The scholarships entitle the winners to 25hr of free flying training, W.J.A.C. wings being awarded when P.P.L. requirements have been satisfied. According to the official W.J.A.C. announcement, one of the young ladies is "tall, dark and attractive, with curly hair"; one is "very attractive, small and dark"; one is "fair and vivacious"; one is "dark and of medium height"; and one is "dark, attractive *and very intelligent*" [our italics]. In addition, three northern entrants, colouring unspecified, were to take trial lessons at Newcastle.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News



Four members of the Air Council keep guard as the coffin containing Lord Trenchard's ashes lies in state in the assembly hall of the Air Ministry. On the right are Air Chief Marshal Sir Dermot Boyle, Chief of the Air Staff (in foreground) and Air Chief Marshal Sir Ronald Ivelaw-Chapman, Vice-Chief of the Air Staff; on the left are Air Chief Marshal Sir Francis Fogarty, Air Member for Personnel (in foreground) and Air Chief Marshal Sir Donald Hardman, Air Member for Supply and Organization.

Lord Trenchard's Funeral

ON February 21st the ashes of Lord Trenchard were interred in the R.A.F. chapel in Westminster Abbey. The words of the burial service were spoken by Canon A. S. Giles, Chaplain-in-Chief of the R.A.F., while the Central Band played Handel's *Dead March in Saul*, and trumpeters sounded the R.A.F. call, the Last Post and Reveille.

During the funeral procession to the Abbey from Whitehall, the pall bearers were Marshals of the Royal Air Force Lord Portal of Hungerford, Lord Douglas of Kirtleside, Lord Tedder, Sir Arthur Harris and Sir William Dickson, with Admiral of the Fleet Sir Philip Vian, Field Marshal Lord Alexander of Tunis, and Sir John Nott-Bower, Commissioner of Police of the Metropolis.

The Union Jack which draped the coffin was that first used at the unveiling of the Cenotaph by King George V and which later covered the coffin of Field Marshal Lord Haig. Lord Trenchard's Service-dress cap and sword rested on the coffin.

The insignia bearers were Air Chief Marshal Sir Ralph Cochrane, Maj. Gen. E. Hakewill-Smith (Colonel of the Royal Scots Fusiliers), and Sir Henry Dalton (Assistant Commissioner of the Metropolitan Police).

The Duke of Edinburgh, in the uniform of Marshal of the R.A.F., represented the Queen, while the Government was represented by the Prime Minister, together with Sir Winston Churchill and many former members of past governments.

A Valiant flew over the procession in salute and the R.A.F. ensign was flown from the Abbey. As the coffin was carried down the steps of the Air Ministry, where it had lain in state, a piper of the Royal Scots Fusiliers, Lord Trenchard's old regiment, played the Highland Lament *Flowers of the Forest*.

The funeral service was attended by a large number of friends, relatives and representatives of the Services and other organizations, and the final Blessing after the committal of the ashes was given by the Archbishop of Canterbury.

Service Pay Increases

VERY substantial pay increases for all three Services, announced last week, will take effect on April 1st. Preparation of the new scales began last summer after it was pointed out, during the debate on last year's Air Estimates, that some particular inducement was required to encourage long-term engagement in the forces.

The problems of the three Services, which are to some extent different, have been stated at various times during past years; but in the final analysis the difficulty is a shortage of long-service recruits in the majority of ranks and trades. If the shortage can be taken to have resulted from the fact that a Service career is now less attractive than one in civil life, then the Services' recruitment problem can be alleviated by improving conditions. Broadly, there are three ways of doing so. Firstly the unavoidable turbulence of frequent postings all over the world, with the instability of home and family which this brings with it, can be reduced as far as possible. Secondly, conditions of service can be improved by providing more amenities of every kind in the form of housing, recreation centres, spare-time activities and other benefits. The third—and possibly the greatest—attraction is, of course, higher pay.

While all these improvements are being actively pursued in the R.A.F., the first of them is extremely difficult to achieve, and the second, though well advanced, now must rank as a long-term project. The most immediate and in these days the most potent appeal is higher pay; and the recently announced increases are a very realistic effort to bring the Services onto the same financial plane as equivalent careers in civil life.

The increases attempt to provide not only a *pro rata* increase for each rank and trade, but a distribution of increases which will encourage long service and make the attainment of high rank financially worth while. The actual sums now involved have already been widely publicized; in fact a bulletin of the complete new rates was issued to every man in the R.A.F. within 48 hours of the release of the Government White Paper—a fine example of personnel-relations work. It can be seen from these that pay increases have been carried right up to the highest ranks and that pensions and tax-free terminal grants will now make it much more worth while to take on the longer engagements.

As far as flying personnel are concerned, a greater financial incentive has been provided for flying, which constitutes a tangible official recognition of the aircrew status. The distribution of flying pay is also readjusted so that all ranks up to and including air commodore will receive it. Moreover, flight lieutenants, squadron leaders and wing commanders will all get the same sum of £401 flying pay per year; and an air commodore will receive flying pay much higher than that of any rank in the old system, by which he previously had none at all. The large increase is, of course, added to the increase in basic pay.

For other ranks an entirely new principle has been evolved, namely, that pay shall be graded right from the day of "signing on" according to the length of service which is offered. Basic pay for the National Serviceman has been only slightly increased, with a small extra sum for those over 21.

Three scales of pay have been instituted, as follows: Scale 1 for five years service, or less, Scale 2 for between five and nine years, and Scale 3 for nine years or more. Though the increases in pay for these periods may appear to be slightly less than those for the other two Services, it should be remembered that the R.A.F. has adopted the principle of the tax-free bounty to a greater extent than the other Services. These bounties themselves are higher than their equivalent before the new scheme and are given on engagement and on release. The scales particularly benefit apprentices who generally serve engagements of at least nine years, since as soon as they enter the Service proper, they pass immediately to one of the more advanced scales of pay from their already increased apprentice wage.

To conform with the technical requirements of V-bombers and some other aircraft, the new aircrew category of Air Electronics Officer has been introduced. These officers will wear a new single-winged brevet bearing the letters A.E. and will serve for nine years or more as General Duties aircrew officers.

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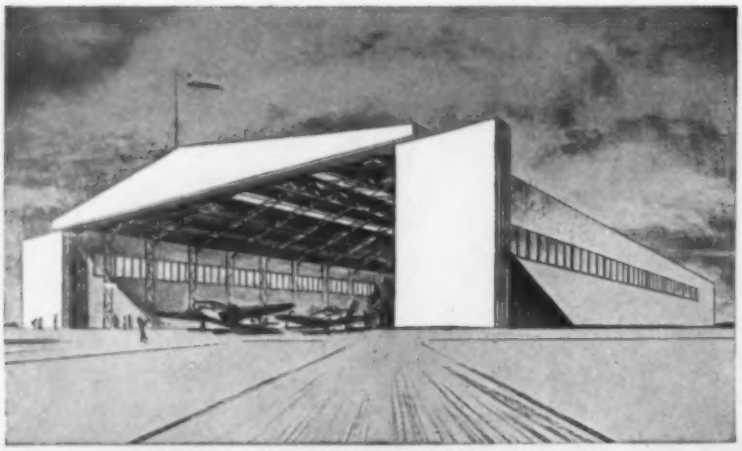

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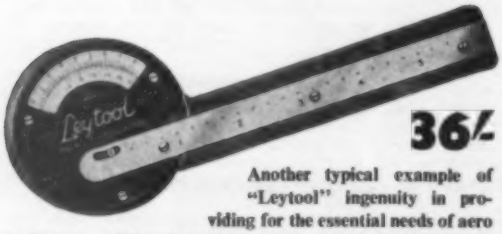

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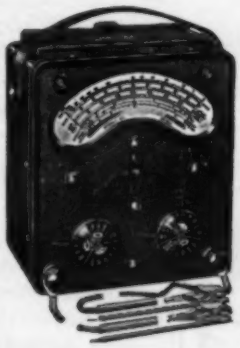

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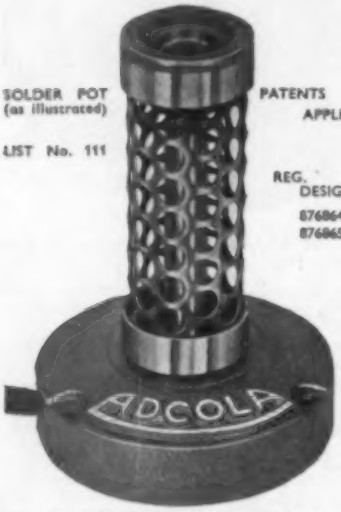

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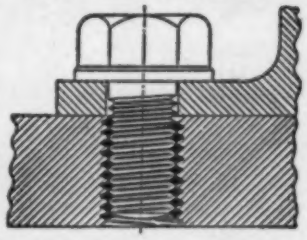

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

APPLICATION No. 729. From Eagle Aviation Ltd., of 29, Clarges Street, London, W.1., for a Seasonal Normal Scheduled Service with Viking or Dakota aircraft for the carriage of passengers, supplementary freight and mail between London (Blackbushe) and La Baule (Montoir) at a frequency of three return flights weekly during the season from 1st June to 30th September inclusive each year, for a period of 10 years, commencing 1st June, 1956.

APPLICATION No. 202/2. From Silver City Airways Ltd., of 1, Great Cumberland Place, London, W.1., for an amendment to the terms of approval of the Vehicle Ferry Service which the company are approved to operate with Bristol 170 aircraft on the route Lydd-Calais, during the season from Easter to October each year for the period up to 31st October, 1961, so as to permit operation of the service throughout the year. The Company also request permission to combine the Vehicle Ferry Service with the Lydd-Calais sector of their All Freight Service (Application No. 293).

APPLICATION No. 96/2. From Dragon Airways Ltd., of Newcastle Municipal Airport, Woolsington, Newcastle-upon-Tyne, 3, for permission to combine at the Company's discretion the Normal Scheduled Services Newcastle-Paris and Newcastle-Liverpool so as to operate on the route Newcastle-Liverpool-Paris at a frequency of up to three return flights weekly, with traffic rights on all sectors. This proposal is conditional on the approval of Application No. 718 from Dragon Airways Ltd. for permission to take over the Normal Scheduled and Internal Services of Hunting-Clan Air Transport Ltd. from Newcastle-on-Tyne.

APPLICATION No. 730. From British Overseas Airways Corporation of London Airport, Hounslow, Middlesex, for permission to include an optional traffic stop at Manchester (Ringway) on the Normal Scheduled Services between London and Montreal which they are authorised to operate on the routes set out as Routes Nos. 16 and 18 in Schedule 'A', Part I, of the Terms of Reference issued to the Council by the Minister of Civil Aviation on 30th July, 1952.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3, Dean's Yard, London, S.W.1., from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections.

THE Air Transport Advisory Council also give notice that the following applications from Starways Ltd., of Liverpool Airport, Liverpool 19, have now been withdrawn:—

APPLICATIONS Nos. 716 and 717 for Seasonal Inclusive Tour Services in conjunction with the Cathedral Touring Agency, Liverpool, on behalf of Liverpool City Caterers, between Leeds (Yeadon)-Exeter, and London-Exeter. These applications were advertised in "The Times", "The Aeroplane" and "Flight" on Friday, 10th February, 1956. [4898

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APPLICATIONS are invited for the post of Metallurgist/Radiologist in British Overseas Airways Corporation.

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TECHNICAL Assistant required with Knowledge of general aircraft maintenance and inspection for work in Schedule and Planning Dept. Please apply in writing to: Engineer Superintendent, Field Aircraft Services Ltd., London Airport. [4893

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HANDLEY PAGE (READING) LIMITED, The Aerodrome, Woodley, Reading, Berks, have vacancies for Senior Stressmen for interesting work on Civil Aircraft. High commencing salaries will be paid and new houses to rent will be offered to successful applicants. Also required are Senior and Intermediate Design Draughtsmen and Weights Engineers. Superannuation and Life Assurance Scheme is in operation for all staff employees. Please send full particulars of experience etc. to the Personnel Officer. [0280

SCOTTISH AVIATION urgently require Planning Engineers for work on their Prestwick Twin Pioneer project. Applicants should have served a recognized Engineering Apprenticeship and have previous Aircraft Planning experience. Houses immediately available. Reply giving details of training and experience to Personnel Manager, Scottish Aviation Ltd., Prestwick Airport, Ayrshire. [4858

BRITISH OVERSEAS AIRWAYS CORPORATION have vacancies at London Airport for Airframe Fitters for aircraft maintenance and servicing. Previous skilled experience in this work or completed apprenticeship essential. Minimum age 21. Good pay; Pension Scheme; Sickness and holiday pay; Sports and Social Club. Apply Ass't. Staff Manager (Appointments), London Airport, near Hatton Cross (Buses 203 and 90B)." [4844

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SCOTTISH AVIATION urgently require Draughtsmen and Designers for work on their Prestwick Twin Pioneer and other new projects. Applicants should have served a recognised Engineering Apprenticeship and have previous experience in the Aircraft Industry. Excellent conditions and pension scheme in operation. Houses immediately available. Reply giving details of training and experience to Personnel Manager, Scottish Aviation Limited, Prestwick Airport, Ayrshire. [4859

WEAPONS-SYSTEM Assessment. Technician required for work on weapons-system studies. Previous knowledge of this subject an advantage but not essential. Applicants should have the ability to tackle new problems. Knowledge of mathematics to about degree standard and a background of aeronautical engineering experience is desirable. Write stating age, experience and salary required to:—Staff Officer, Handley Page Ltd., Cricklewood, London, N.W.2. [4885

YOUNG Engineers required by Armstrong Siddeley Motors for work on gas turbine aero engine performance prediction, flight analysis and associated problems connected with the flight development of engines. Degree, or equivalent required, a mathematical bias an advantage. Previous experience of this type of work desirable but not essential. Good salaries and pension scheme. Applications, with full details of age, experience and qualifications to Reference FL/P, Technical Personnel Manager, Armstrong Siddeley, Coventry. [0471

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TECHNICAL Authors (Senior, Junior and Intermediate), must be capable of reading engineering drawings. Duties will include the preparation of descriptive and instructional literature on a wide range of subjects—mainly mechanical and hydraulic. Knowledge of methods of print production and associated processes an advantage. Instruction given in Junior post which is intended to be progressive. Please write in detail, quoting reference number 19, to:—The Personnel Manager, (Technical Employment), de Havilland Propellers Ltd. Manor Road, Hatfield, Herts. [0421

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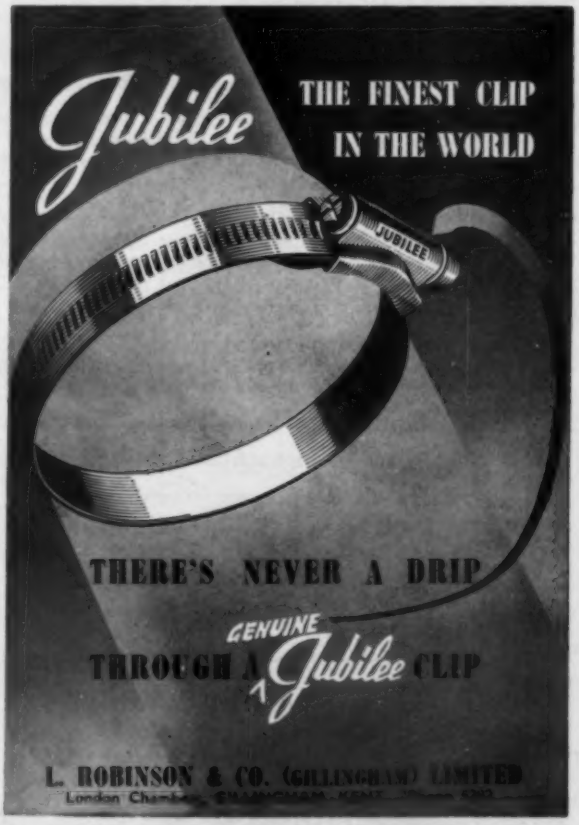

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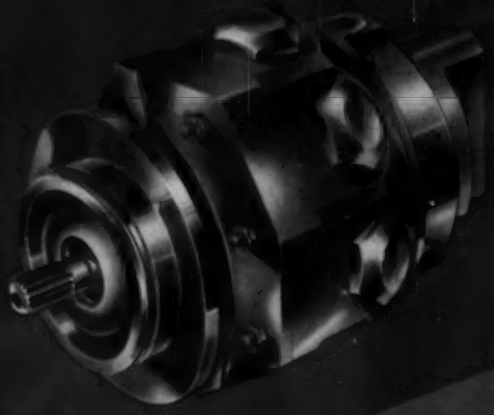

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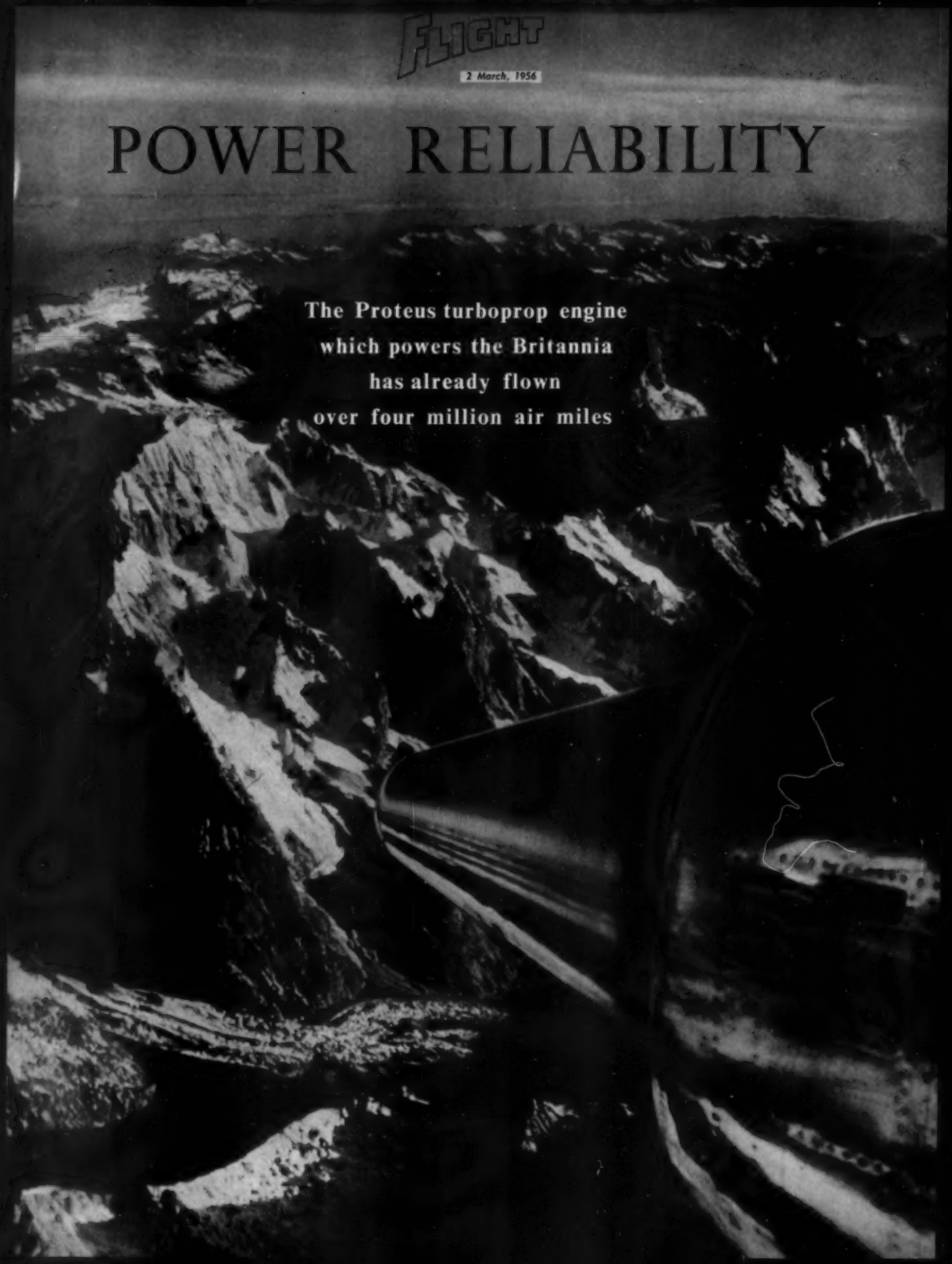

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